Subterranea

The Magazine for Subterranea Britannica

Subterranea Britannica **September 2016 Issue 42**

IN THIS ISSUE

Subterranea Britannica is a society devoted to the study of man-made and man-used underground structures and the archaeology of the Cold War. The society is open to all and its membership includes all walks of life. Members are invited to contribute to this magazine even if this just means sending very welcome snippets from newspapers and magazines.

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Front cover photo: Shell hoist for one of the 6" guns of Devil's Gap battery in Gibraltar. This coastal defence battery covered the Bay of Gibraltar and approaches to the harbour. The cartridge lift is in an adjacent room, cartridges and shells being loaded separately. Since this photo was taken in 2006, the underground magazines have been tidied up and lit to allow visitors to see this well preserved and complete example of a coastal defence battery. The battery was decommissioned in 1954. Photo Nick Catford

Back page upper: The Union Flag flies defiantly over Rock Battery on the north face of Gibraltar at the northern end of the Upper Rock, overlooking the Spanish town of La Linea. Photo Nick Catford

Back page lower: Sub Brit members beneath Rome in one of the larger passages in the 'Claudium' tuff quarry. The quarry - a stone's throw from the Coliseum - is named after the Temple of Claudium (54AD) of which just a small part remains above the quarry. This mediaeval quarry was for volcanic tuff - used extensively throughout Rome as a building stone. Much of the quarry is full of deads and later infill and so the impressive original dimensions are not always visible. The spoil beyond the group has been dumped down an original mine-shaft. Photo Clive Penfold

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Chairman's Welcome

Martin Dixon

The area around Rhydymwyn in Flintshire has been mined over the centuries for limestone and for the metal ores (lead, copper and zinc) it contains. But this small Welsh town holds another underground secret. In World War II the Rhydymwyn Valley held a mustard gas factory and this lethal product was stored in vast purpose-built underground chambers. This reserve (mercifully not used) was kept until 1958 before destruction. A local group (the Rhydymwyn Valley History Society) has been researching the site for many years and trying to gain permission for public visits to these storage tunnels.

The Sub Brit Committee agreed to give the RVHS a modest grant to enable the purchase of safety equipment and at the end of June a number of Sub Brit volunteers took part in a dress rehearsal for public visits, under the watchful eye of the Department of the Environment, Food and Rural Affairs, the site owners. An article describing the visit is elsewhere in this edition but since its writing I'm delighted to say that DEFRA have now given approval for public visits. Many congratulations to all the team that have made this possible.

Rhydymwyn joins a growing list of underground sites that have opened their doors to the public in recent years (Ramsgate Tunnels, the LT Museum disused station tours and Fan Bay immediately spring to mind). I think the Rhydymwyn project is a great example of how Sub Brit works and how we can really make a difference. We often work with other local or specialist groups, lots of which have Sub Brit members amongst their own membership. We don't try to be the sole player or to take over from others. What we can provide is a range of support – specialist advice, modest grants and 'boots under the ground' when needed. The Committee is always keen to hear about other projects that we might support that open up (not literally!) underground space to a wider audience.

Our last Committee Meeting was held at the Black Country Museum in Dudley and a summary of the meeting is within the magazine. We had two new Committee members present helping to ensure that we get an injection of new ideas and perspectives. The Black Country Museum contains a reconstructed colliery and the adjacent Dudley Canal Trust operates regular trips into the Dudley Canal Tunnel and Limestone Mines which together make a splendid day out. Many thanks to Sub Brit member John Beckerson for arranging the venue. If other members have access to meeting space that the Committee might use for our regular meetings (normally on a Saturday) then please get in touch with Linda on secretary@subbrit.org.uk.

Those at our Spring Day Meeting in April will have seen, alongside a fascinating set of presentations, that we had some Sub Brit branded baseball caps and bump caps for sale. The latter are particularly useful for protection against minor underground bumps but not where there is a danger of falling objects. And if you're flying with Ryanair they can be worn on board without eating into the baggage allowance or looking like a construction worker. It isn't cost-effective to post these out to members but drop a line to info@subbrit.org.uk if you're attending an event and would like to pick one up (both are sold at cost – baseball caps at £5 and bump caps at £10).

Our next major event is the Autumn Day Meeting with associated visits from 15 – 17 October in and around Belfast; there's a preview in this edition. As far as I recall it's our first 'official' SB visit to Northern Ireland and I know we'll get a very warm welcome there. Many thanks to Chris Rayner and local member Alistair McCann who have been busy arranging the programme. The talks and visits promise to be first-rate and I hope to see many members there for what will be only my second visit to the region.

chairman@subbrit.org.uk

Mike Hawkins

I am sorry to have to inform readers that Sub Brit member Mike Hawkins has passed away following heart failure.
Mike had been a Sub Brit member since 1998.
He had a background in radio (callsign G8WOY)
and went 'silent key' on June 6th.
Mike was able to source a lot of ROC kit
(including numerous Burndept radios) for ROC post restorers.
We pass our sympathies to his wife Ann and family.

SUBTERRANEA BRITANNICA DIARY

Summary of Forthcoming Events

Sub Brit specific events

2016

17 September Paddock open day

15 - 17 October SB Autumn Meeting Belfast

1 November Copy deadline for Subterranea 43

Mid December Subterranea 43 published

2017

21 January SB Committee meeting

22 April SB Spring Meeting, London

May or June (tbc) SB Scandinavian Weekend

Other underground-related events

2016

27 - 28 August Cuckfield ROC Post Open Days (28th am only)

28 August Carrs Mine Trips & Open Day, Nenthead, Cumbria

2 - 5 September Fortress Study Group Conference & AGM, Chichester

All September Scottish Archaeology Month

6 - 11 September The International Mining History Congress, Linares

8 - 11 September Heritage Open Days, England

9 - 14 September Association for Industrial Archaeology Conference, Telford

10 September Portadown ROC Post Open Day

10 September Reigate Caves Public Open Day

10 - 11 September European Heritage Open Days, Northern Ireland

10 - 11 September Carrs Mine Trips & Open Day, Nenthead, Cumbria

12 - 18 September Doors Open Days, Scotland

17 - 18 September London Open House

September Open Doors, Wales - Every weekend in September - programme available August 2016

28 October Carrs Mine Trips & Open Day, Nenthead, Cumbria

18 - 21 November SFES (Société Française d'Etudes des Souterrains) Congress, Arras, France

2017

6 - 10 March Hypogea, Cappadocia

22 April South Eastern Industrial Archaeology Conference (SERIAC), Worthing

28 April - 1 May Railway & Canal Historical Society AGM (RCHS), Exeter

2 - 9 May Fortress Study Group Malta Study Visit

11 - 13 May International Early Engines Conference, Elsecar, South Yorkshire

23 - 26 June National Association of Mining History Organisations (NAMHO) Conference 2017, SE England

1 - 6 September Fortress Study Group Conference & AGM, Fareham & Alderney

For web links to these events please visit www.subbrit.org.uk/events
or contact the Society concerned

If you know of other relevant events run by other societies, please let us know so that they can be advertised in the next edition and on the website

Minutes of Committee Meeting 25 June 2016 at The Black Country Museum, Dudley

By Sub Brit Secretary, Linda Dixon

Attendees: Martin Dixon (Chairman), Linda Dixon (Secretary), Nick Catford, Tony Radstone, Bob Templeman, Richard West, Paul Sowan, Tim Wellburn, Jason Hughes, Alistair Graham Kerr. Mike Scott and Chris Gray attended as a co-opted members of the Committee. Apologies were received from Richard Seabrook and Chris Rayner.

Committee Business

We were pleased to welcome Jason and Alistair, both elected to the Committee at the AGM in April. We also welcomed Mike Scott and Chris Gray who have also shown an interest in joining and came along to see how we work. Sub Brit's Accounts have been filed with Companies House and the Charities Commission and Gift Aid payment has been received from HMRC.

We enjoyed the hospitality of the Black Country Museum and also enjoyed popping out to the museum to sample their various hostelries for lunch! Thank you to member John Beckerson for arranging. If other members have ideas of venues to hold committee meetings, then please let us know.

Grants

Following successful applications, grants have been made to Rhydymwyn Valley History Society (equipment), Portadown ROC Post (leaflets) and Brunel Tunnel (booklet). We agreed to produce more leaflets for Paddock and to consider leaflets for Drakelow and Broadway ROC Post.

PR

Mike Scott has a background in media and will have a go at taking this on, although he has limited time. We agreed to work on a list of 'experts' who can provide knowledge/answers on specific topics/sites.

Day Meetings

All agreed that the Spring Meeting and AGM went well with a good turn-out. Lunch went well and the day still made a small surplus. Chris Rayner is working on Belfast as a venue for the Autumn Meeting on 15 October, with two days of visits on Sunday/Monday 16/17th. We decided to hold the Spring Meeting in 2017 on 22 April; probably at Imperial in London.

Visits/Trips

The **Rome** weekend in May went off well (see report in this issue). The pilot trip to **Gibraltar** also went OK – we will try and arrange a further trip when we know when our contacts are available**.** We will look at Isle of Wight/ Portsmouth and possibly Scandinavia for trips in 2017. See *Diary* for other trips.

Day Visits/Trips

Martin is working to try and set up a repeat trip to Daws Hill; the School Bursar has changed so this is likely to be next year. We're also investigating Clapham South/Common and a repeat trip to Westcott. Several trips were discussed and will be advised to members in due course. Sub Brit had a stand at the Fawley Hill Steam Weekend in May.

Reports from the Committee and Matters Arising

The hard hats bought for the Daws Hill VIP visit will be donated to Drakelow. We will do a reminder in the December issue of *Subterranea* to remind members about membership renewals – with a view to reducing the cost of chasing members to renew in the new year. We are continuing to research ways of providing *Subterranea* for the visually impaired – any ideas from members on this are welcomed. A small number of Bump Caps and Baseball Caps with the Sub Brit logo are still available – contact Linda Dixon if you'd like one.

Sub Brit Site Directory

All agreed that it would be useful to update this, possibly with a 'fresh' look, and we will all review to provide any changes required. Any help with this would be welcomed.

The **Next Committee Meeting** will be held on Saturday 8 October at Kelvedon Hatch.

News

Miscellany compiled by Nick Catford & Paul Sowan

NEWS – ARCHAEOLOGY

Going underground in the Stone Age

We live in such a brilliantly illuminated 21st century that it is difficult to envisage even the rudimentary domestic lighting, and virtually non-existent street lighting, of eighteenth-century England. What artificial light there was used at that time had hardly progressed beyond methods used in the Stone Ages, depending on burning animal or vegetable oils and fats.

Mankind's acquaintance with fire almost certainly commenced with inflammations resulting from lightning strikes, which the two together were doubtless as terrifying as they might be in your back garden today.

The deliberate production and use of fire, for lighting, cooking, and comfort, clearly dates from prehistoric times. Some archaeological evidence having a bearing on this from the Bronze Age has recently been reviewed in the *Archaeological Journal*, although a Stone Age origin is very likely.

The manufacturers of Stone Age tools and hunting weapons hit upon the idea of striking flints together to produce carefully crafted cutting implements. Bashing flints together might conceivably result in sparks, although trials by your scribe after dark in his back garden have proved disappointing! Flints are, of course, found abundantly embedded in the beds of chalk so widely found in England from the Yorkshire Wolds southwards and westwards to Kent and eastern Devon.

Another mineral found as nodules in the chalk, although more sparingly, is iron pyrites (FeS_2 – iron II disulphide). Banging together a lump of flint and a lump of iron pyrites results in much more satisfactory sparks, sufficient indeed to set alight carefully dried plant material such as moss (tinder) and thus start a controllable fire.

The cited paper notes 52 reported occurrences of the two minerals found together with human inhumation (burial) and cremation remains in Britain. These may have been cave burials, burials in 'built caves' inside burial mounds, or straightforward graves. The majority of these 'strike-a-light' kits from a third of the sites have been dated to the second half of the third millennium BC.

In course of time it was found that iron and flint struck together are a better source of sparks than using iron pyrites, which is in any case much less satisfactory as it is a brittle material liable to disintegrate into useless fragments. But iron-flint 'strike-a-lights' had to wait until the smelting of iron ore to metal had been discovered.

SOURCE: TEATHER, Anne, and Andrew CHAMBERLAIN, 2016, Dying embers: fire-lighting technology and mortuary practice in Early Bronze Age Britain. *Archaeological Journal* 173, 188–205.

A deep vertical shaft investigated at Broadstairs, Kent

The opening-up of a well or mine shaft in a school playing field naturally causes some alarm, and calls for investigation. A subsidence at Broadstairs following prolonged and heavy rain in early 2014 revealed a shaft twenty metres deep, oval on plan, with a diameter ranging from 1.29 to 1.92 metres. Rescuing a child from such a deep hole would have been, if called for, a worrying exercise, as rescue operations might dislodge further near-surface material.

Members of the Kent Underground Research Group were called in to advise and investigate, and were at the site on 1 and 9 March 2014. The Group is experienced and equipped for such tasks, and fully aware of all risks and how to mitigate them.

A desk study included examination of the earliest available detailed large-scale plan for the area (Ordnance Survey of 1872) and published well records. The area had been, in 1872, a brickfield, and the local water table in the underlying chalk was estimated to be at least twice as deep as the visible bottom of the shaft. A site record made in 1996 indicated that surface brickearth and Thanet Sand at the site had been stripped down to bare chalk, and the ground then levelled up by almost a metre of made ground to make the playing field.

The shaft was brick-lined at the top, but cut in chalk lower down. No footholds or supports for any timber structures were found in the walls. Two metres of material removed from the bottom of the hole proved to contain building demolition rubble and modern rubbish, largely presumably some of the material brought in to level up the playing field. Further fill below this level was not removed, so the total depth of the shaft was not ascertained. It is possible that the remaining fill could subside further if there is another void below it.

The top of the shaft rigged for the descent. Photo from KURG

Numerous brickfields have been investigated and recorded in north and east Kent, and many of them feature wells and / or underlying chalk mines made in connection with the brick-making process. The conclusion arrived at by the investigating team at Broadstairs was that the shaft in question was most likely to be an abandoned well, not a mine entrance.

A well here would necessarily have to be at least 40 metres deep, to reach water. And there would have been no point in mining chalk more than 30 metres below ground, as galleries could perfectly well have extracted material closer to the surface. Mine galleries would have to be above the local water table to obviate the risk of flooding.

No evidence was found for any deliberate brick capping over the top of the shaft as a safety measure. Possibly no more than a makeshift wooden cover had been laid over the top, or some old tree stumps thrown down the shaft and earthed over. The heavy rainfall and the weight of material thrown down the shaft probably caused the infilling material to collapse into the void, any organic material previously supporting it having decayed.

SOURCE: LE GEAR, Rodney F, 2016, Nineteenth-century well subsidence at St. Peter's, Broadstairs. *Archaeologia Cantiana* 137, 303–304.

A medieval 'well' near Sandwich, Kent

Investigation of a site marked as 'Convent well' on historic maps of land near Sandwich has revealed the well-preserved remains of a medieval tapped spring and water supply conduit. Although the word 'well' in modern usage rather suggests a deep vertical shaft, in the past it was applied to quite shallow excavations dug to tap natural springs.

The convent well investigation revealed the remains of a small medieval well house building, inside which was a square stone-built tank at a depth of around two to three metres below the modern ground surface. Water from the spring was collected in the tank, where any suspended sediment could be allowed to settle. A pipe (or 'conduit'), probably made of lead, would have been provided to convey clear water from the upper part of the tank to the point of use. The structure included Kentish ragstone and, for the finer work, Caen stone imported from the underground quarries near that city in Normandy.

SOURCE: PARFITT, Keith, and Helen CLARKE, 2016, 'Scouring the conduit head at Woodnesborough': investigations into Convent Well, near Sandwich. *Archaeologia Cantiana* 137, 127–147.

NEWS - HEALTH & SAFETY

Four miners in China rescued after being trapped underground for 36 days

A gypsum mine in Shandong province, east China, collapsed on 25 December 2015 with sufficient force that it registered a magnitude 4 on the Richter scale, leaving 29 people trapped. Of these, 11 miners were rescued the following day and one was pronounced dead.

A rescue operation began five days after the collapse, when crews using infrared cameras detected the men, weak with hunger and waving their hands. They were able to tell those above ground that they were sheltering in underground passages.

Rescue teams began drilling towards them, first reaching them on 8 January when provisions, clothes and lamps were sent down. The operation was slowed by complicated geological conditions that made the tunnels unstable. After 36 days trapped underground four miners were eventually led to safety. Thirteen miners are still missing.

The rescued miners are led to safety

The gypsum mine and other local pits were ordered in October 2015 to stop production because of a risk of sinkholes but kept operating. Two days after the mine collapsed, its owner died after jumping into a well.

China's mining industry is notoriously perilous, even by the standards of the country's record of industrial deaths during its recent period of breakneck economic growth. China is the world's largest producer of coal. Authorities say colliery accidents killed 931 people last year; a figure some rights groups claim is likely to be considerably lower than the real toll.

SOURCE: *The Guardian*, 29 January 2016

NEWS – MILITARY AND DEFENCE

The BBC's 'War Book'

For the first time, the BBC has given detailed access to the plans it drew up in the Cold War for a Wartime Broadcasting System to operate in the event of nuclear war detailed in a document known as 'War Book'.

The War Book reveals a world of meticulous BBC planning. The Wartime Broadcasting System (WTBS) – referred to in the book as 'Deferred Facilities' – would have operated from eleven protected bunkers spread across the UK. The BBC had a studio in each of the Regional Seats of Government, usually with five staff drawn mostly from nearby local radio stations.

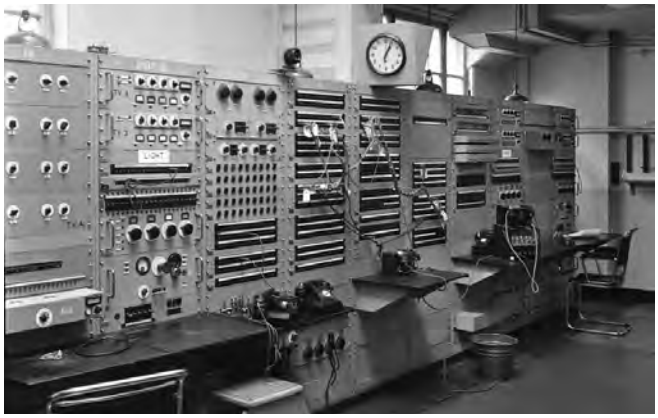
The BBC's headquarters would have been a bunker at the Engineering Training Department at Wood Norton in Worcestershire, where ninety BBC staff would have been assembled, including engineers, announcers, twelve news editors and sub-editors and, ominously, 'two nominations

from Religious Broadcasting'. Output would have been controlled by the government.

To keep the public amused during Armageddon, a collection of cassette tapes of old radio programmes including the *Goon Show*, *Just a Minute* and *Round the Horne*, was kept in a grey locker at Wood Norton. It was eventually realised, however, that these were redundant. If there had been a nuclear attack, radios would probably have been dependent on batteries and these would have needed to be conserved for news and important announcements.

Choosing the staff to go into the bunkers was a 'delic' or 'designated' to go underground. In later, less authoritarian days, they were 'invited' to do so. Some staff opted out. There is a note in one file stating that Huw Wheldon, Managing Director of Television, 'refused to take part in matters dealing with wartime broadcasting'.

Curiously, the Director General had no place in the bunkers. In the later editions of the plan at least, the BBC teams were to be led by the Head of Radio 4, perhaps because it would have been a radio-only operation. There was scepticism in BBC ranks about whether this would all go to plan. Roy Walters, a former senior radio news editor, remembers taking part in a Cold War exercise and coming to the conclusion that 'it would probably have been done on the hoof'.



Control room at Wood Norton, probably late 1950s or early 1960s before the bunker was built. The two operator positions seen here are labelled 'Light (Radio 2)' and 'Third (Radio 3)'. This could be the reserve small facility at Wood Norton

Government codewords for activating the BBC plan are blacked out in the BBC War Book. One did slip through. The codeword for authorising a national warning was, oddly, 'Falsetto'. There was no special payment for underground duties but the chosen staff could draw £250 cash advance of salary.

It was all very polite. They would be offered transport to their posts, but if they took their own car, they would not be able to park it there. As for kit, 'informal clothing only will be necessary'.

The letter asking them if they were 'willing to fulfil' emergency duties advised them that they should bring reading material and 'small recreational items'. The letter was to be destroyed after reading. If war loomed even closer, another letter would be handed over. This said: 'You have been selected for emergency duty and you will be going to …' The bunker's name would be filled in at the time.

Delicately, the letter also said: 'The length of your stay cannot be foreseen, but it might be several weeks.' Staff were advised to take clothes, soap and towels for thirty days. The food in the bunkers (free of charge) would be in packs, with five daily menus. These would provide, it was said, 2,200–2,400 calories per day, with a vitamin supplement. Sleeping would be communal, though suitably segregated.

Broadcast warnings of a nuclear attack would have come from the BBC headquarters at Wood Norton. Peter Donaldson, a Radio 4 newsreader with a known and trusted voice, recorded the most recent warning announcement. It begins: 'This is the Wartime Broadcasting Service. This country has been attacked with nuclear weapons. Communications have been severely disrupted, and the number of casualties and the extent of the damage are not yet known. We shall bring you further information as soon as possible. Meanwhile, stay tuned this wavelength, stay calm and stay in your own homes.'

The BBC War Book very nearly did not survive the end of the Cold War. When the WTBS was stood down in 1992, the BBC's then Head of Administration, Margaret Salmon, ordered that it should be destroyed. This order was ignored and the book and its predecessors going back to the 1950s and associated files were taken to the BBC Written Archives Centre near Reading to be preserved for posterity.

SOURCE: *BBC News Magazine*, 23 July 2016

Possible bunker discovered in Falmouth

A Falmouth woman has launched a bid to prevent the construction of a 275-bed student accommodation block by Falmouth Docks due to a site of historic interest lying beneath the concrete.

Deborah Irvine is trying to get listed building status for what she believes could be a Victorian bunker on the site of Ocean Bowl on Pendennis Rise – a site which is currently the subject of a planning application for a five-storey students' residence with a seven-storey tower block attached.

The tunnel before infilling with gravel in 2013

She was first alerted to the possible existence of a bunker at a meeting of campaign group *Save Our Falmouth*. One of the people at the meeting was from Ocean Bowl. He has a number of photos of the bunker both internal and external and an aerial photo from 1947.

She said: 'I was talking to Richard, from Ocean Bowl, and he said "you know there's an underground bunker". He's got a wealth of photographs of the interior and exterior, and aerial photography from 1947. It was possibly used in World Ward Two as an air-raid shelter.'

Deborah said that the bunker – which she believes was infilled with gravel in 2013 by landowners Pendennis Shipyard – was attached to a tunnel which passed under Bar Road to come out in scrubland near the bottom of Melville Road. When the owner of Ocean Bowl discovered the bunker entrance, he was told by locals that they had crawled through the tunnel as children.

Deborah said the entrance to the bunker had been discovered when the operators of Ocean Bowl were clearing back undergrowth at the site, but because that was after 2000 it had not been included in the Fortress Falmouth conservation plan drawn up by English Heritage.

SOURCE: *This is the West Country* (website), 23 July 2016

Mistley AAOR sold for £990,000

The former Anti-Aircraft Operations Room at Mistley in Essex was sold at auction for £990,000 on 26 May 2016. The two-acre site already has planning permission to turn the Grade II listed bunker into three dwellings and the erection of a further 28 homes in the grounds. The building has been empty since 2002.

By July 2014 the bunker had been empty for 12 years and is looking somewhat dilapidated. Photo Andy Hebden

SOURCE: *BBC News – Essex,* 27 May 2016

Cold War bunkers in Albania

A recent article in *The Guardian* reports on Cold War structures in Albania. Most visible in the otherwise picturesque landscape are 'tens of thousands' of pillbox-scale dome-shaped concrete gun positions, in present times variously disused, put to new uses, or (occasionally and expensively) demolished. Their purpose was to obstruct an invasion that never happened. These structures are so conspicuous in the Albanian landscape that miniature models of them are sold as souvenirs for tourists (your scribe has one on his desk, brought back by his brother).

Rather more secret, at least during the almost fifty years of communist dictatorship led by Enver Hoxha from 1944 to his death in 1985, are much larger deep Cold War bunkers in or near the capital, Tirana, due to open soon to the public. The first (already open, with an entry fee of 300 Lek, about £1.70) is a 'huge bunker' on the city outskirts, built to protect Hoxha and his associates from nuclear attack.

Richard Eilers has reported on his visit to this 'visitor attraction' which reportedly has featured on Facebook, and is known as Bunk'Art. A 200-metre entrance tunnel is reported leading to a five-level sub-surface structure. Some rooms contain Cold War displays; others have art displays, but most are empty.

In central Tirana, about to open 'soon', is to be found the 'House of Leaves', a red brick villa once used as the headquarters of Sigurimi, the Albanian secret police and telephone tapping network. This is scheduled to open as the 'Museum of Surveillance' in 2017, with displays of 'spy equipment'. A few hundred metres away close to Skanderbeg Square is 'the biggest bunker of the city centre' which connected all the Albanian ministries, currently being prepared for public access.

SOURCE; EILERS, Richard, 2016, On the radar: Albania's bunker museums cast new light on a dark era. *The Guardian (Travel Supplement),* 25 June 2016, page 2.

Starbucks restaurant to be built on site of ROC 6 Group Control at Norwich

Plans to turn a former 6 Group ROC Control at Norwich into a new Starbucks and retail unit on the edge of the city have been recommended for approval.

Developer Sigma (Marlborough) is seeking permission to transform the area on the Norwich ring road to include a 3,000 sq ft retail unit and a drive-through café. But it has already met with objection from people living nearby and Sprowston Town Council.

The 6 Group control room in March 2002. Photo Nick Catford

Until 1991, the site served as the group headquarters of 55 ROC underground monitoring posts in Norfolk for thirty years. Since then, numerous applications have been made to redevelop the area, which planning officers described

as vacant and overgrown. The bunker was demolished in July 2008 to put a halt to a spirited local campaign to restore the bunker as a tourist attraction.

The latest proposals would include a 29-space car park, with two disabled bays and access to the site via Chartwell Road. And while the café would be open from 7am to 10pm, developers are seeking permission to keep the retail unit open to 11pm daily.

Numerous objections have been made from people living nearby, mostly on traffic grounds.

SOURCE: *Eastern Daily Press*, 19 July 2016

Zero Station discovered on Norfolk estate

A secret Second World War bunker lay hidden under a Thorpe St Andrew estate for almost 70 years. Now the underground wireless station, on private land at Pinebanks, off Yarmouth Road, has been protected as a scheduled monument on the advice of Historic England.

The Special Duties Organisation, a branch of the Auxiliary Units, was formed after the sabotage side of the resistance had already been established. Its members were never told of the many patrols in existence all around the country. The Special Duties Organisation's role involved radio communications and spying. The section's personnel consisted of spies, cut-outs, out-station radio operators and the people who would operate the control and IN-stations, also known as zero stations.

The IN-Station at Pinebanks which would have received messages from OUT-Stations in enemy-occupied areas, was found by a retired groundsman in the gardens of Pinebanks in 2012.

It has now been awarded special protected status to preserve it and to celebrate its history. Heritage Minister David Evennett said: 'This underground wireless station is a rare and unusual example of our Second World War heritage and deserves to be protected. It is a reminder too of the often forgotten role so many civilians played in the war effort often acting in secret and undercover.'

It is thought that the bunker was built under the Jarrold family's tennis court at Pinebanks in the 1940s. Details only emerged after the family's former gardener, who had to sign the Official Secrets Act, told a young groundsman about the construction work he had witnessed. The gardener did not disclose this until after his retirement, and he did not reveal the location, with this emerging later.

SOURCE: *Eastern Daily Press*, 21 May 2016

Kelvin Hughes factory demolished

The Kelvin Hughes factory in Hainault, Essex had been producing radar since WWII until it closed in 2014 when the current owner, Smiths Industries, opened a new high tech factory at Brimsdown still trading as Kelvin Hughes.

The surface blockhouse was the entrance to the tunnels. Photo Keith Ward

ROTOR photographic display units and other equipment was produced here and there was an underground chamber for testing radar equipment under the car park at the rear of site. It would have been similar to the Kelvin Hughes two-level room found in ROTOR bunkers.

Since closure the site has been used by Essex Police as a training facility but all attempts to arrange a visit for Sub Brit were unsuccessful. The entire site has now been cleared and houses are being built despite massive local protests.

The entrance to the underground facility was from an external surface blockhouse.

SOURCE: Keith Ward

Paddock Information Collection

The Paddock Information Collection is a compilation of articles, documents, images, maps, plans, publications and reminiscences (a total of 192 objects) showing the history of Paddock

(the Cabinet War Room Standby Bunker in Brook Road, Dollis Hill, north London) and the surrounding area from country farm through design, construction and various uses up to the present day to create a valuable research resource (a total of 435 pages).

Notable among the 26 sources of information are Andrew Emmerson, Bob Jenner, *Blitz then and now*, Brent Archives, *Britain from Above*, British Telecom Archives, The National Archives, Nick Catford and Subterranea Britannica.

The complete Paddock Information Collection is available at www.1001solutions.co.uk/paddock.htm as a 260 Mb download.

SOURCE: Bill Ridgeway [bill@compsols.wanadoo.co.uk]

Another German bunker is opened to the public in Jersey

More than ten tonnes of earth and rubble have been excavated from a German bunker in the Channel Islands to allow the public access for the first time since the 1960s.

Part of Jersey's Occupation history was uncovered in April during an excavation of the bunker at Les Landes Common, which was filled in by the States more than 50 years ago. The Channel Islands Occupation Society were granted permission to perform the excavation by the Environment Department earlier this year.

The recently excavated entrance to the FL232 bunker. Photo Tony Pike

The FL232 bunker, which has original German artwork painted on the inside, will be used to display photographs of the pilots and aircraft crew who died during the war. The bunker was used to control an anti-aircraft gun.

SOURCE: *Jersey Evening Post,* 4 April 2016

Ghosts caught on camera at Anstruther!

Creepy pictures appear to have caught apparitions on camera at the former ROTOR bunker, now a popular tourist attraction at Anstruther, Fife.

During the summer an incident in which a woman fainted and had apparent connections with several spirits have also had visitors and paranormal experts scratching their heads. In one of the photos seen here, two figures are seen at the end of the long corridor that forms the entry to the bunker, which is situated 100 feet underground. The photo was taken by a guest on a *Scottish Ghost Nights* tour of the attraction.

Lisa Tedstill, managing director of UK Ghost Nights and Scottish Ghost Nights, which conducts regular paranormal events at the Bunker, said: "I think there's definitely something there. It's one of the best photos I've ever seen of apparent spirits." Lisa added that the corridor was empty apart from her group at one end of it.

During a separate visit by the same company, a female visitor felt ill in the Bunker's dormitory and then fainted just as a REM pod sensor alarm – a popular piece of ghost hunting equipment – went off. The face of a man was then seen at the dormitory window. In another set of pictures in a room that served as an office, a ghostly

The ghostly figures can be made out at the end of the corridor

presence appears in one photo but not in another one taken directly before it.

Mediums have also reported connections with several spirits, most of them former military personnel who worked there.

SOURCE: *Scottish Evening Telegraph,* 13 July 2016

Bunker for Italy's Royal Family opens in Rome

A bunker designed for Italy's former royal family has opened to the public for the first time, after being abandoned for seventy years, at Rome's Villa Ada park.

The air-raid shelter was constructed between 1940 and 1942 to protect the Savoia family in the case of bombing during WWII. Surrounded by thick vegetation, the bunker is located at the base of the Colle delle Cavalle Madri hill, about 350 metres from the former Savoia residence at Villa Ada.

The 200-square-metre shelter includes a sitting room, two bathrooms and air purification system, and its two access doors, made of iron and concrete, weigh a combined 2,400kg and are 20cm thick.

The blast doors at the entrance to the royal shelter

The restoration of the bunker began last October and was overseen by Roma Sotterranea, an association which collaborates with the capital's archaeological authorities in providing tours of Rome's underground sites.

Guided tours, which cost between €10 and €15, are available on Saturdays and Sundays, and some holidays dates, or by special appointment for groups. Members of Subterranea Britannica were amongst the first visitors during a study weekend on 6 May 2016 (see page 60).

SOURCE: *Wanted in Rome*, 1 April 2016

NEWS – MINES AND MINING

National Association of Mining History Organisations Conference – South East England 23 – 26 June 2017

The NAMHO Conference 2017, will be held in the South East of England, based around Godstone in Surrey, over the weekend of 23-26 June 2017.

The conference will be hosted by the Wealden Cave & Mine Society and the theme for 2017 will be "Mining History Organisations - achievements and challenges"

A varied and exciting programme of field trips and lectures are already taking shape and we have a great venue with ample space for camping on site or a good selection of hotels/pubs/B&B's nearby if you would prefer!

Godstone Quarry, one of the field trips planned for NAMHO 2017. Photo Nick Catford

2017 also coincides with the 50th anniversary of the Wealden group and there will be the chance to join with our members both past and present over the weekend, to help celebrate our first 50 years! There will be plenty of food and drink on offer and even a band on Saturday night to keep us all entertained.

Bookings will open early in 2017, but watch for further updates on our website at: www.namho2017.info or for Facebook or Twitter followers search: namho2017

Hope to see you there!

SOURCE: Matt Clark, Chairman NAMHO 2017

New thoughts on Neolithic flint mines

An article in a recent issue of *British Archaeology* suggests Britain's flint mines, over 5,000 years old, were something more than solely utilitarian industrial sites. Why did people go to such trouble to dig mine shafts up to six metres deep, communicating with radiating horizontal galleries, when flint could be found plentifully at the surface?

The mines at Grimes Graves, just inside the southern border of Norfolk, date from around 2,600 to 2,300 BC. Significantly earlier ones occur on the South Downs north of Worthing in West Sussex, and southeast of Stonehenge in Wiltshire. Archaeological evidence, such as deliberately scratch-marked lumps of chalk, reportedly suggests human activity other than mining in the dark subterranean tunnels.

Similar evidence and interpretations have also been reported from mines in Jylland (Jutland) in Denmark, and at Spiennes (visited by Subterranea Britannica) near Mons (Bergen) in Belgium. Interpretations of enigmatic features found in archaeological contexts as evidence of 'ritual' rather than utilitarian activities is nothing new.

SOURCE: TEATHER, Anne, and Lasse SØRENSEN 2016, More than flint: the dark underground of Neolithic mining. *British Archaeology* 149, 50–53 and 55.

Winter 2015 / 2016 bat hibernation records for mines and quarries, Surrey

The Surrey Bat Group, in collaboration with the Wealden Cave & Mine Society, monitors bats hibernating underground in Surrey each winter. Two or three visits are made each year, between December and February. The sites include underground quarries (once worked for building stone), mines (once worked for hearthstone), some miscellaneous excavations such as garden follies and the like, and some surface structures such as 1890s fortifications, World War II pill-boxes, and lime kilns.

As expected after a mild winter, hibernating bat counts were low, with the highest number recorded in the subterranean quarry for hard chalk used as a building stone, a secure gated site near Dorking, where during three visits a total of 51 sightings were recorded.

Seven of the 17 or so British species were recorded, these being Natterer's, Daubenton's, Whiskered, Bechstein's, Myotis spp., Brown long-eared and Basbastelle bats. Not all the British species hibernate underground or in the categories of sites noted above.

SOURCE: SURREY BAT GROUP, 2016, Hibernation site checks, December 2015 – February 2016. *The bat detector* 80, page 3.

Fire Brigade rescues lost teenagers searching for Pokemon in the Box mines

A group of teenage boys who entered the Box mines to search for Pokemon got stuck 100ft below ground and had to be rescued by the fire brigade. They had entered while playing the popular smartphone game Pokemon Go, where users search real-life locations for digital creatures.

The mine covers an area of about 72 sq miles and is very intricate with "lots of windings and different junctions",

Damien Bence, from Dorset and Wiltshire Fire and Rescue, said. He said the teenagers, aged about 16 and 17, had managed to find their way to an open-air part of the underground labyrinth called the Cathedral, from where they were able to get a phone signal and call the fire service. Three fire engine crews and two rope rescue units responded to the call.

The 'cathedral' chamber at Box is open to daylight and is the only place in the mine where mobile phones will work. Photo Matt Emmett

Mr Bence added: "The fire service doesn't have a statutory duty to enter underground systems; normally we would call on other experts such as mine rescue. But in this case there are lots of local experts and guides, and we used one of those. We managed to lower down water and radios so they could communicate with us.

"They were looking for these Pokemon creatures and surprisingly they didn't find any, but it's obviously leading people into dangerous situations, such as this, and things are likely to escalate if people are going to follow the rules of this game."

He advised anyone thinking about going into the Box mines not to, unless they know exactly what they are doing and have a map and an experienced guide with them.

SOURCE: *BBC Wiltshire* News, 16 July 2016

Access to Emmer Green chalk mines, Caversham, Reading

Emmer Green might be described as a suburb of Caversham, a settlement on the north bank of the Thames opposite Reading. It was historically in Oxfordshire, but early last century was absorbed into the Borough of Reading. There are three chalk mines below the site of a former brickyard, each having a vertical shaft for access.

One of the unlined chalk galleries in the Scout mine. Photo Nick Catford

Two of the mines have been linked underground, with one of the shafts kept accessible from within the 89th Reading Scouts' land. The other shaft is now sealed at the top. The Scouts have now, assisted by external funding, installed a fixed steel ladder in the 70 ft deep shaft on their land. They have had published locally illustrated accounts of their two interlinked mines, primarily to attract potential members to the Scouts.

Membership of the Scouting movement is not however a requirement for access which was granted to Subterranea Britannica for a visit on 30 July. A trip report will appear in *Subterranea* 43. The third mine 'Hanover' outside the Scouts' land is no longer accessible. To see pictures taken in 2003 see http://www.subbrit.org.uk/sb-sites/sites/h/hanover_chalk_mine/index.shtml

SOURCE: ANDERSON, Chris, 2006, Rare chance to explore mines. *Reading Chronicle*, 12 May 2016, page 10.

Two new tourist attractions open at Llechwedd slate caverns at Blaenau Ffestiniog

The Llechwedd Caverns in the town of Blaenau Ffestiniog have been transformed into a trampoline playground aptly named Bounce Below. Huge springy nets suspended underground propel visitors around the old mine to create a unique subterranean bounce park.

You enter via an old mine train and are then presented with a staggering maze of 10,000 square feet of nets. There are three trampoline levels, one at 20 feet, one at

60 feet and the tallest at 180 feet off the ground. To move between trampolines, you can take an industrial-sized slide, crawl through a tunnel, or descend a spiral staircase deep into the cavern

The second new attraction is called Zip World Caverns. Journey through an Indiana Jones-type adventure environment that has been inaccessible for nearly 200 years. The new experience boasts exhilarating underground zip lines, rope bridges, obstacles and tunnels, suitable for adults and children aged 10 and above (must be able to reach 1.8metres), and lasts up to three hours.

The previous underground attractions including the deep mine tour are also still available.

SOURCE: Llechwedd slate caverns web site http://www.llechwedd-slatecaverns.co.uk/adventure

Restoration work at Magpie Mine, Sheldon, Derbyshire

Surface buildings and structures at Magpie Mine, at Sheldon, are to be conserved by the Peak District Mines Historical Society thanks to a grant of £74,000 from the National Lottery Fund.

This hilltop lead mine was worked during a period of over 250 years, through to the 1950s. The oldest standing structures, stone-built, date from 1840 and include an agent's house and smithy, and two large chimneys. The most recent are a steel headframe and an associated corrugated iron shed. A survey by the society in 2013, funded by Natural England, revealed the need for stabilisation. Especially at risk is the square chimney, built in 1840 to serve a steam-powered winding engine.

Photo Phillip Sissons

An internal inspection of the chimney revealed serious weakness, the internal stone lining having collapsed. The investigation, carried out by a person descending the inside of the structure on a rope, revealed that daylight could be seen through gaps in the surviving *in situ* stones. The HLF grant will assist repairs to the chimney and an associated ground-level flue. The society will also provide funds. The work is scheduled for completion by the end of the summer of 2016.

SOURCE: Peak District Mines Historical Society Ltd. press release, *Magpie Mine square chimney conservation project* (2016).

Visit report, Dinas silica mines, Glynneath, South Wales

Quartzite or silica rock was once mined near Dinas Rock and the Sychryd Gorge at the head of Glynneath. The mine entrance, open to all wanting to explore, is a short walk from the Dinas Rock car park, and has long been a favourite location for beginners underground, for those taking their first steps underground in the dark, or practising underground photography or surveying.

There is a reasonably level well-worn pathway straight in from the entrance. It is a pillar and stall mine in quite steeply dipping rock beds, with the opportunity for scrambling about in older workings up-dip to the left, or down-dip to water on the right.

A recently published report of a short visit, with three underground photographs, has appeared in the *Newsletter* of the Chelsea Spelaeological Society. The photographs reveal a comfortable ceiling height, and a manageably sloping floor.

Old mine tubs in the Dinas mine. Photo Laurie Parker

It should be emphasised that all standard safety precautions must be taken. Groups should be counted in and out, helmets and suitable footwear and head torches should be worn and spares carried, and word should be left with a responsible person on the surface specifying the location and the intended exit time. That person should call cave rescue (via the police) if a safe exit report is not received.

SOURCE: HEALEY, Liz, et al., 2016, CSS evening trips to the Silica Mines. *Newsletter: Chelsea Spelaeological Society* 58 (4–6), April–June 2016, page 29.

Box Mine back door no longer accessible

There were originally many entrances to Box Quarry in Wiltshire. The principal entrances which were all adits were Eastgate, Northgate, Westgate, Bridgegate, Backdoor, Clift and what is now called Jacks Workings, named after a stone quarryman. One by one the entrances have been sealed with only Backdoor and Jacks remaining open.

The Clift entrance, where quarrying ceased in 1968, is also accessible but is securely locked. This is the entrance used by the fire brigade when called out to rescue lost

people as it is a 'walk in' entrance close to the most interesting parts of the quarry.

For many years Hanson UK, who own the quarry, have tolerated access by experienced caving groups. Both entrances were gated a few years ago but keys have been readily available. The Backdoor entrance has always been the most popular; it is located at the bottom of a cliff face close to the *Quarryman's Arms* pub in Box. Access involved climbing over a wall and down a wooded path which skirted round a tennis court in the rear garden of a large house. The cliff face and path down from the road are not owned by the householder but there were no fences between the path and the back garden.

Opening the back door. The tennis courts are a short distance behind the photographer

Cavers have always been asked to be discreet, quiet and as unobtrusive as possible when accessing the Backdoor so as not to upset the householder and his guests who would sometimes use the tennis court. The householder in return tolerated this access. In recent years however large numbers of visitors, not members of recognised caving clubs, have started using the Backdoor and this appears to have finally tipped the balance against underground visitors.

The householder has built a fence across the path to the back door and also has put a fence up on the road to stop people climbing over the wall, so the Backdoor entrance is now out of bounds. Jacks entrance remains accessible with the usual arrangements for obtaining keys still in place.

SOURCE: Roger Gosling

Valentia Slate Ltd for sale, Republic of Ireland

Valencia Island lies off the southwest coast of Ireland, west of Killarney. It is one of the less well known locations for the underground quarrying of slate in the British Isles. The quarry, or mine, is currently up for sale by Valentia Slate Ltd (so spelled in the cited source). It is described as a 'tremendous tunnel through the mountain large enough to hold all the processing work and machinery and would dwarf a double-decker bus'. Slate from here has been used on the roofs of the Houses of Parliament, Westminster Abbey and Cathedral, St Paul's Cathedral, and several London Underground stations.

SOURCE: ANON, 2016, Quarry for sale. *Outcrop* 53, page 9 [Underground slate quarry of Valentia Slate Ltd, Valentia Island, west of Ireland]

NEWS – MISCELLANEOUS

SERIAC offers bursaries for industrial archaeological research in southeastern England

SERIAC (South Eastern Region Industrial Archaeology Conference) is an informal committee of representatives of industrial archaeology societies in Berkshire, Greater London, Hampshire, Kent, Surrey and Sussex, with the addition of Subterranea Britannica represented by Paul Sowan, who speaks for 'the great underground county' of the southeast.

The six 'above ground' county groups, in rotation, organise an annual conference. That for 2016 was organised at Kingston-upon-Thames by the Surrey Industrial History Group, and was attended by over 120 persons.

Finance is in the hands of each group in turn and, over the years, surpluses have accumulated, from which bursaries are awarded for IA research in the region. Field recording or archival research are eligible for financial support, and a report and / or a display or lecture at the following conference are conditions. Bursaries are not restricted to members of the six county groups or indeed of Subterranea Britannica.

For further details or to submit proposals or applications (in writing), contact the SERIAC secretary, currently Martin Snow of the Sussex IA Society, at 43 Orchard Avenue, WORTHING, West Sussex BN14 7PY.

New concert/party/wedding venue opens in Rotherhithe

London's newest performance space is 191 years old. The vertical entry shaft to the Thames Tunnel at Rotherhithe was begun in 1825 by engineer Marc Brunel and the tunnel itself – the first of its kind in the world, which runs 75ft below the surface of the river at high tide from Rotherhithe to Wapping – was completed with the help of his son Isambard Kingdom Brunel in 1843.

Large ramps to facilitate commercial horse-drawn traffic beneath the river were never built because of cost, so the tunnel was only used by pedestrians. The entrance shaft became a grand hall and the tunnel a

place of entertainment, dancing, promenading and, later, prostitution and petty crime. In 1865 the tunnel was bought by the East London Railway and the shaft became a flue for smoke from steam trains, which still blackens the brick.

Now a 42ft-high chamber at the top of the 50ft diameter shaft has been converted into an atmospheric entertainment, wedding and party venue by architects Tate Harmer. Before construction could start, many different agencies had to be consulted: TfL, which insisted on a flood door to the new entrance; Southwark council; and Historic England, which scanned the walls to check for traces of "frescoes" mentioned in a 19th-century poster (there weren't any).

Every part of the 12-ton staircase, including the huge cruciform brace for the top platform, had to be fed through a 5ft x 7ft door and hand-winched into place. The entire project was completed for a paltry £170,000 – the first £120,000 from an AIM Biffa Award, from a fund created by the waste disposal company and administered by the Association of Independent Museums, and the rest through fundraising.

The opening programme included chamber music, an "iconoclastic" pop-up Bellini opera, and excerpts from Shakespeare, with scope for much more due to the excellent acoustics of the shaft. It's a huge new development for the Brunel Museum.

The Thames Tunnel shaft was the venue for Sub Brit's very successful 40th anniversary dinner in June 2014 with members, guests and caterers having to negotiate an awkward scaffolding stairway.

SOURCE: *Evening Standard*, 14 April 2016

Secret Rooms installed inside abandoned manhole covers on the streets of Milan

In this new series of outdoor installations artist Biancoshock has turned abandoned manhole covers on the streets of Milan into cramped miniature rooms complete with hanging artwork, kitchen utensils, and

tiled walls. The artist says the admittedly humorous pieces are meant to draw attention to a more serious issue in Bucharest, where many hundreds of people now live underground in the sewer system.

SOURCE: *Colossal* (website), 4 April 2016

The Great Tunnel not yet located, Liverpool

The astonishingly enterprising Friends of Williamson's Tunnels, based at Edgehill in Liverpool, have been busily and successfully locating, gaining access to, and archaeologically investigating various parts of Williamson's bizarre subterranean excavations in that district since their foundation in 1996. Much of Merseyside is built on red sandstone, a readily tunnelled rock, and members of Subterranea Britannica have, in collaboration with the Friends, enjoyed visits to Williamson's and many other tunnels than those created by their hero, up to and including the Liverpool Overhead Railway Tunnel and the Mersey Tunnel.

The Great Tunnel in the 1880s

The latest issue of the Friends' newsletter to arrive has news of a recent practical investigation to attempt to locate the fabled 'Great Tunnel', of which 1880s photographic evidence is preserved on the National Railway Museum's archives at York.

This required permission of two site owners, to gain access to the expected location of the portal and to make a hole through a retaining wall underneath an adjoining site. The said retaining wall was found to be immensely thick, six feet, and is thought to have been emplaced to bear the weight of a World War II anti-aircraft gun position. Sadly, all the hard work of creating a hole four feet wide and five feet high through six feet of brickwork was not rewarded by success. The removed brickwork was replaced and the wall surface made good. At least some useful negative evidence has been gained!

SOURCE: COE, Les, and Steve MORAN, 2015, The Great Tunnel. *The Mole* 30, 10–11 [The Friends of Williamson's Tunnels are at 15–17 Chatham Place, Edge Hill, Liverpool L7 3HD (post only) and www.williamsontunnels.com]

Another lost tunnel in Liverpool

Another rock-cut tunnel in Liverpool, sealed at both ends, is known to exist below James Street. It was discovered when that street was widened, and runs from Fenwick Street to near Derby Square. When found it was recorded to be seven feet high and nine feet wide, and at least 80

yards long. The bore, around 22 feet below ground level, was surveyed in 1855 and again in 1910, and at some time access via three manholes was provided for City engineering staff. No recent visit is reported.

SOURCE: ANON, 2016, Other lost tunnels: James St. Tunnel. *The Mole* 30, page 11.

Escape the bunker challenge comes to London

An escape game where players are challenged to break free from a claustrophobic underground bunker is coming to the capital.

Escape the Bunker, which runs this weekend, is inspired by the 2016 science-fiction film *10 Cloverfield Lane*. In the film, Michelle, played by Mary Elizabeth Winstead, wakes up after surviving a car accident to find she is trapped underground with two strangers – who tell her that a chemical attack has rendered the air unbreathable, and their only hope is to remain inside. She must escape in order to discover the truth.

In teams of five, players must complete four puzzles in 45 minutes to escape from the 40 sq ft bunker built in a studio in Seven Sisters.

Much like the film, players begin trapped in a dingy bedroom. Once they work out how to escape, they crawl into the living quarters of the bunker – designed to look like the film – where they must find clues and codes to open the exit door.

One of the film's most gruesome scenes – involving a barrel of acid – is referenced in the game, as is Michelle's home-made gas mask, fashioned in case she escapes. One puzzle involves an air ventilation machine – a reference to the challenge to fix one in the thriller.

The bunker has been created by London-based entertainment firm Escape Rooms, who designed the game where teams must puzzle their way out of a locked room in less than 60 minutes.

SOURCE: *Evening Standard*, 22 July 2016

Sad news from Liverpool

It is immensely saddening to learn that Steve Moran, a founder member of the Friends of Williamson's Tunnels in 1996, died on 15 June 2016. In early April he was diagnosed with an inoperable and 'very aggressive' brain tumour.

Your scribe has been fortunate enough to enjoy Steve's company during quite a few visits to Merseyside, and as a delegate to an international conference at Starigrad Paklenica on the Adriatic coast of Croatia. His legacy is an impressive record of sterling work under Edge Hill during the last 20 years.

SOURCE: Friends of Williamson's Tunnels

NEWS – PUBLICATIONS

Archaeology of mining and quarrying in England

DETAILS: NEWMAN, Phil, *et al*., 2016, *The archaeology of mining and quarrying in England. A research framework for the archaeology of the extractive industries of England. Resource assessment and research agenda.* National Association of Mining History Organisations: xviii + 360pp [ISBN 978-1-87187-41-5]

Subterranea Britannica has, almost from its birth in 1974, pressed the case for the recognition by English Heritage (now Historic England) of underground man-made spaces as heritage assets. It has, from the first Ancient Monuments Act in the 19th century, been possible to Schedule a once-inhabited natural cave, and an excavated void, as an Ancient Monument. But rock-cut underground spaces are not eligible for Listed Building status other than those actually *built*, so tunnel portals can be listed, but unlined tunnels can't, the argument being that you don't *build* a hole in the ground.

A breakthrough came when EH introduced its Monuments Protection Programme (MPP), when it was recognised that post-medieval and more modern wartime defence works, civil engineering infrastructure, and mines and quarries were as important elements of England's history as so many prehistoric burial mounds, Roman walls, and medieval abbeys and the like.

Teams of members of the National Association of Mining History Organisations (NAMHO) member societies, including your scribe representing Subterranea Britannica, assisted with data and a review of, especially, mines and underground quarries. Many metal mine sites were subsequently Scheduled, although generally only on account of surviving surface or near-surface structures, the underground parts still being overlooked.

In Surrey two important groups of technically innovative 19th-century lime kilns were duly Scheduled at Betchworth and Brockham, the latter site also encompassing a hearthstone mine shaft. But although EH in its assessment of underground building stone quarries in east Surrey has declared those at Merstham as undoubtedly appropriate for Scheduled Ancient Monument status, the MPP ran out of financial support, and the proposal has not been implemented.

Subterranea Britannica members, again via NAMHO, also supported a Department of the Environment survey of mining remains of all kinds in the British Isles: this was aimed at assessments of subsidence risk, mines being seen as 'statutory nuisances' rather than heritage assets. Many British mine sites qualify equally for recognition under both headings!

This year, at last, mineral extraction has been taken into serious consideration as worth the attention of English Heritage (now Historic England). NAMHO was commissioned around five years ago to take up where MPP had stopped insofar as the mineral industries of England was concerned. Funding was provided for teams of NAMHO member societies' members to review English mining and quarrying of all kinds and dates, and to publish a Research Assessment and Research Agenda, constituting a Research Framework. The active encouragement of the late Jon Humble of English Heritage was an important factor in the project's success. His death at the too-early age of 57 on 30 November 2015 robbed mining history of an 'establishment' figure who was at home underground as much as in an office.

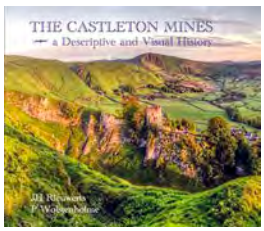
The resulting report is a substantial A4 volume of 360 liberally illustrated pages. Opencast operations, surface and buried structures, and associated underground archaeology are all considered. Your scribe represented Subterranea Britannica in this project, and made a small contribution focusing especially on extractive industries other than coal and metalliferous ores.

The scope is from Prehistoric to Roman and Modern, so ranges from primitive flint and metal mining and industries to building-stones and bulk minerals to coal and metal mining and miscellaneous materials such as barytes, fluorspar, gypsum and potash and rock-salt. Even such small-scale resources as arsenic, cobalt, gold, and uranium, to name only a few are mentioned.

The volume was published primarily for the information and guidance of national and local government planners and decision-makers, but a limited number of copies has been made available at £15 + p/p for other interested persons. For availability, contact Dr P.F. Claughton at NAMHO via the Peak District Mining Museum, The Pavilion, Matlock Bath, Derbyshire DE4 3NR.

This is a remarkably inexpensive volume compared with the prohibitively costly volumes published for the DoE study of mining instability (at around £4,000 or more for a complete set).

Mines of Castleton, Derbyshire



DETAILS: RIEUWERTS, James H., and Phil WOLSTENHOLME, 2016, *The Castleton mines – a descriptive and visual history.* Great Hucklow: Hucklow Publishing: 132pp [ISBN 978-0-9563473-6-7] [Copies are available at £30 including packing and postage from Jim Rieuwerts]

That this is an important and reliable book is guaranteed by the name Rieuwerts, a long-established authority on mining in the Peak District. It is handsomely illustrated, mostly in colour, by Phil Wolstenholme. Numerous underground scenes are included, along with some historic images. A reproduction of an Ordnance Survey six-inch map extract, a 1919 edition of a survey first made in 1877–79 forms a helpful frontispiece as it has had superimposed on it mineral vein alignments and mine locations and names. An enlarged version of part of this showing Castleton village and sites west if it, in the text, is most helpful.

Castleton is of course a well-established tourist centre where visitors have a choice of show caves for underground experiences such as the Blue John Mines, Peak Cavern, Speedwell Cavern and Treak Cliff Cavern. However, the text provides a great deal of information on the inner reaches of those places, beyond the reach of tourists, and on a great many other mines the tourists will never see.

The focus is firmly on lead mining, with incidental reference to the gangue minerals such as barytes, calcite and fluorite. It embodies many years-worth of research into a wealth of mining archives, many of which are in private ownership and not generally publicly accessible.

NEWS – TUNNELS AND TUNNELLING

If only it was so simple! Driving the Northern Line extension under Battersea, London

Most members of Subterranea Britannica are probably familiar, perhaps from school geography text-books, of diagrams representing sections through the rock layers under the Weald (an anticline) or the London Basin (a syncline).

These are so grossly simplified that they convey the impression that each bed is of constant thickness and has completely planar upper and lower surfaces, and consists of exactly the same material from end to end. The only things a tunnelling engineer needs to know, you might think, are the thickness of each bed, and the angle at which it is inclined to the horizontal. If only life was so simple!

The Brunels, father and son, were probably amongst the first to discover the geotechnical problems facing anybody tunnelling under London. Site investigations for their pioneering Thames Tunnel (poking holes at intervals across the river bed and bringing up samples) led them to believe that they would be driving all the way from shore to shore through London Clay, an eminently good material for the purpose.

However, it is now known that the upper surface of the clay bed was not the slightly tilted flat surface as laid down on the sea bed so many millions of years ago. There was in fact a deep trench eroded into it, filled with stinking Thames-bottom mud liable to give off methane (highly flammable) and hydrogen sulphide (exceedingly toxic). The tunnel, therefore, started off in sound clay, but was driven into the muck-filled trench. The muck,

swept in by river water, flooded the unfinished tunnel. The sampling points had been too far apart, so did not detect the problem in advance.

The Northern Line extension from Kennington to Battersea, of course, does not run under the Thames. But it is to be driven through London Clay. Site investigation reveals that, as under the Thames, the upper surface of the bed is anything but a flat surface. There are 'steeply inclined cone-shaped hollows into (sometimes through) the London Clay … filled with unconsolidated fine- to coarse-grained drift and often covered by terrace gravels, making them difficult to identify at the surface'. To date 283 site investigation boreholes have revealed two such drift-filled hollows along the intended tube tunnel route.

Other geological problems encountered during tunnelling in London have been presented by geological faulting, where hitherto undetected steeply inclined dislocations have displaced the rock beds either side of it by several metres or more. The risk is of driving a tunnel-boring machines through one sort of rock such a watertight clay into another such as chalk full of flints and water-bearing fissures, calling for a different machine design.

SOURCE: TOMS, Emma, Philippa J. MASON, and Richard C, GHAIL, 2016, Drift-filled hollows in Battersea: investigations of the structures and geology along the route of the Northern Line extension, London. *Quarterly Journal of Engineering Geology and Hydrogeology* 49(2), 147–153.

Proposed under-Thames road tunnel to link Essex to Kent

Highways England announced in March 2016 an eight-week consultation on a proposed Lower Thames Crossing via a new road tunnel to relieve pressure on the existing Dartford crossings.

Two locations were suggested in 2013 for a new bridge or tunnel, one close to the present Dartford crossings, or one linking the M2 with the M 25 via the A13. The second option, with a tunnel downstream of Gravesend, is now preferred.

SOURCE: ANON, 2016, Consultation on Thames road tunnel project gets underway. *New Civil Engineer*, March 2016, page 9

Severn tunnel to close for six weeks from 12 September 2016

Britain's longest main-line railway tunnel, with the exception of the UK end of the Channel Tunnel, is to close for six weeks during the autumn of 2016 for work in connection with electrifying the main line from London to South Wales.

Current for the new trains to Cardiff and Swansea will be taken from an overhead conductor rail, for which additional headroom is needed. The seven-kilometre-long single-bore double track tunnel was made, with considerable difficulty from flooding, in the years 1873 to 1886, and greatly shortened the rail route and journey times to and from South Wales.

Although it was constructed for the Great Western Railway, it was not made wide enough and therefore high enough, for the broad-gauge lines used for so much of the earlier part of that company's network. Providing clearance for the conductor rail is to be achieved by lowering the track bed, not enlarging the bore. Through trains will be diverted from Swindon via Kemble, Stroud, Gloucester and Chepstow during the closure, reminding passengers that the GWR stands for 'Great Way Round' as well as for Great Western Railway!

The Great Western Main Line electrification work will obviously also call for work at a number of other tunnels including the long Box and Chipping Sodbury tunnels, not to mention a great many bridges, although some of these were built for broad-gauge trains. The cited article also includes interesting details of the systems in place to prevent flooding below the river Severn.

SOURCE: CLARK, Rhodri, 2016, Severn tunnel electrification. *Modern Railways*, 73(815), 70–75

Queensbury Tunnel in Yorkshire could be opened to cyclists

There is hope for what could be Europe's longest underground cycle route, through a disused rail tunnel, despite a Highways England estimate that restoration work would be too costly to undertake. The Government-owned company said work will begin to close the 1.4 mile-long Queensbury Tunnel, which lies between Bradford and Calderdale, by summer 2017 – at a cost of £3m – unless another organisation steps forward.

A spokesman for Highways England, which owns the tunnel, stated, "We remain open to the idea of transferring the Queensbury Tunnel to another public body to maintain it. We would also look to offer the owner the estimated £3m funding we plan to spend on closing it. A recent survey revealed that the condition of the tunnel continues to deteriorate and our investigations found it would cost an estimated £35m to make it safe for further use."

The north portal of Queensbury Tunnel. Photo Phil Davison

A group campaigning for the reopening of the tunnel claim the work would cost "considerably less" than Highways England's estimate and they have commissioned a second engineering report, before seeking funding for a Sustrans report to assess the health and economic benefits of the greenway.

They say the tunnel should be viewed as "a health asset for Bradford children for generations to come" and a "magnificent" piece of the city's industrial heritage that will attract visitors. They compare it to the Two Tunnels cycling and walking route near Bath, which receives approximately 265,000 visitors per year.

Before Bradford City Council reportedly agreed to part-fund the study, a spokesman said: "We are continuing to investigate the options around the future of Queensbury Tunnel. However, the tunnel is owned by Highways England and would need a considerable investment of funding to see it reopened and maintained in the future."

Sustrans recognises that the Queensbury Tunnel could provide a link in the West Yorkshire Cycle Network. Sustrans appreciates that the anticipated cost of opening the tunnel for public use is significantly above that for making the tunnel safe. Reopening the tunnel would require commitment and support from the Councils of both Bradford and Calderdale as well as raising public funds to carry out the necessary repair work and build the cycle track. An initial step to investigate the viability of this is to explore what the economic impact of reopening the tunnel to the public would be.

SOURCE: *Road.cc* – the website for pedal powered people. 10 July 2016

Collapsed water tunnel to be repaired, near Howden, Yorkshire

The A614 road near Howden had to be closed when a water tunnel passing under it partially collapsed. The tunnel is to be rebuilt.

SOURCE: *New Civil Engineer*, June 2016, page 9.

Queen Street tunnel, Glasgow

Queen Street is one of the two surviving main stations in Glasgow, Buchanan Street and St Enoch having been closed. It is a terminus for trains from Edinburgh, and also has low-level through lines for local services. Trains approach from the east through a tunnel which has since 20 March 2016 been closed for engineering work due to be completed by the end of the year.

Terminating long-distance trains are being diverted to the low level through platforms or to Glasgow Central station while this work is in progress. The work is preparatory for the electrification of the lines from Edinburgh via Falkirk, with electric trains due to enter service in 2017. The concrete slab track in the tunnel is being renewed, and equipment for overhead wiring installed.

By June, Network Rail engineers had removed over 5,000 tonnes of concrete and rock, created a new 945-metre concrete track base, and installed over 2,000 metres of new rails.

SOURCE: ANON, 2016, Queen Street tunnel progress. *Modern Railways* 73(814), page 22.

Proposed Stonehenge road tunnel, Wiltshire

Stonehenge is recognised as an internationally important monument of great antiquity, an astonishing triumph of prehistoric engineering and transportation, and a major tourist attraction for British and foreign visitors alike. It is very much more than the circle of stones alone. These are the focal point of a vast prehistoric landscape, unspoiled apart from the intrusive visual and aural impact of a major road, the A303 to the south.

Until recently the landscape even closer to the stones was spoiled also by the A344 to the north, not to mention a frankly embarrassing visitor centre complete with a squalid car park and prominent cluster of large rubbish bins presenting a far from an appropriate setting for such a famous place worldwide.

Things have been improved. The A344 was been closed (grassed over) and rerouted out of sight, and a better visitor centre has been provided. But the A303 with its heavy traffic remains far too close to what should be a tranquil site.

There are now, at last, signs that the A303 might, too, be taken out of the immediate view of and to the stones, by rerouting it in a tunnel. Government funding is being made available for road works amounting to £15 bn, including £2 bn for the proposed tunnel. The driving of a 2.8 or 2.9 kilometre tunnel has the potential itself to adversely affect the archaeology of the landscape, as the excavation of deep approach cuttings would entail the removal of vast volumes of chalk and subsoil likely to contain much valuable archaeological evidence – not just objects, but stratigraphical contexts and palaeo-environmental clues.

Archaeological excavation and recording of a very high professional standard will be needed. A relevant Council for British Archaeology document can be found at http://whc.unesco.org/en/list/373.documnts

SOURCE: GRENVILLE, Jane, 2016, A tunnel past Stonehenge? The green light is on. *British Archaeology* 149, 44–47 and 49.

Geotechnical challenges overcome in converting the Farnworth rail tunnels north of Manchester

Electrification of the Manchester to Preston rail line called for two parallel tunnels at Farnworth to be replaced by a single-bore double-track bore sufficiently wide to accommodate track, trains and overhead power lines. One of the older tunnels was completed in 1835 wide enough to take both up and down tracks, but as trains increased in size there came a time when it was not possible for two to pass each other. Accordingly, a second narrower tunnel was opened in 1880. Both the 1835 and the 1880 tunnels were brick-lined and 300 metres long.

The 1835 tunnel has now been enlarged to take two tracks, modern trains, and overhead power lines. As it was

not acceptable to close this busy line during conversion, single-line working was introduced through the 1880 tunnel with the signalling reconfigured for bi-directional running, while the older tunnel was widened. This meant enlarging a brick-lined horseshoe profile tunnel 5.89 m wide and 5.76 m high to a concrete-lined circular bore of almost nine metres diameter.

Widening the 1880 tunnel only 1.5 metres from the older bore still in use called for great care. The first phase of boring called for driving through old brickwork, rubble, rotted wooden sleepers, and made ground. This was strengthened by injecting grout through the old tunnel lining to consolidate the material to be bored through. Temporary support for the tunnel being widened was provided by pumping foamed concrete through the single central tunnel shaft. This was strong enough to support the older structure, but soft enough to be bored out later. 7,500 cubic metres of material was pumped in during 15 days.

Tunnel Boring Machine 'Fillie' in place on 24 July 2015. Photo from Network Rail

All this having been done, an 8.83 metres diameter TBM was brought into action. This compares with the 7.1 metres diameter Crossrail TBMs, the 8 metres London super-sewer ones, and the 8.8 m machines used for the Channel Tunnel running tunnels.

The Farnworth TBM was 10.5 metres long and weighed 400 tonnes. Because the machine had to cut through a mix of varying proportions of mechanically different materials (old brickwork, made ground behind the old tunnel lining, and foamed concrete), progress was slow, and cutting tools on the TBM had to be changed frequently.

SOURCE: SMALE, Katherine, 2015, Farnworth tunnel widening. *New Civil Engineer*, 10 December 2015.

The world's longest and deepest tunnel completed, Switzerland

The 57 kilometre (35 miles) Gotthard Base Tunnel under the Alps between Switzerland and Italy was formally opened on 1 June 2016. This will allow reduced journey times for international passenger and freight trains between Zurich and Milan.

The new line will 'almost completely' replace the older one opened in 1882. It will be used initially for freight services, with passenger services running from December 2016. The whole tunnel is in Swiss territory, the Italian border being some way further south. Tunnelling commenced in 1999, with breakthrough in 2010.

The first train emerges from the tunnel

To date over 500 test trains have transited the tunnel, some of them at up to 275 kph. The capacity in service is to be more than 300 trains each day, running at speeds of 250 kph in both directions. This is the third Gotthard tunnel, the first being a rail tunnel opened in 1882, followed by a road tunnel completed in 1980.

Initial plans for the Base Tunnel were conceived 68 years ago, so the project was carried through to completion rather more speedily than our own tunnel under the English Channel, which took rather longer to progress from idea to actuality (1807 to 1994)! The new tunnel took 17 years to make, from the first blasting of rock to opening. The TBM used was 410 metres long. Altogether there are, including the running tunnels, 152 kilometres of new bored tunnels in this latest work under the mountains.

For those who fancy an unusual rail tour, SBB (Swiss Federal Railways) is offering (until December 2016) tickets for a special passenger service southbound through the new tunnel, and back through the higher-level old one. The outward journey is to include a stop at Porta Alpina station, which lies within the new tunnel at a depth of 800 metres below the mountain. This station, although completed and intended to serve passengers to and from Sedrun, is in fact now scheduled to be used only for maintenance and emergency purposes. When the full passenger services timetable commences on or about 10 December 2016, Porta Alpina will not be a scheduled stop.

The original Gotthard route is to retain a much reduced passenger service from 2017 but does, of course, offer a much more scenic ride than a 35-mile tunnel. Its long-term future is in some doubt. There is to be, in the short term, a summer weekend tourist return ticket from Zurich to Bellinzona (still in Switzerland), from April 2017.

The old route will be reviewed in 2025 with the possibility of closure unless the new tunnel is fully used to capacity. Parts could be closed. The government of Switzerland has declined to back a proposal for World Heritage Status, although the 19th-century engineers were amongst the pioneers of very long tunnels, and of spiral tunnels inside mountains to gain height.

An historic plan reproduced in *Newcomen Links* shows the four spiral tunnels inside the mountainside on the approaches to the 1882 rail tunnel. These are, of course, not easy to appreciate from the windows of overnight trains. Innsbruck–Milan trains cross the Alps on a surface line through the Brenner Pass, rather than a tunnel, and travellers can appreciate the spiral tunnels provided to gain height on that line.

The primary purpose of the base (low-level) tunnel is not passenger services but goods trains, with the intention of taking heavy lorry traffic off the roads through scenic landscapes greatly valued by tourists. Up to 260 freight trains a day are forecast; these will be scheduled to complete the journey from Erstfeld (Switzerland) and Pollegio (near Biasca in Italy) in around 25 minutes, rather than up to two hours as at present.

The Swiss Railways (SBB) website www.gottardo2016.ch/en is reported to be worth visiting for technical information, images and videos.

SOURCES: ANON, 2016, Gotthard Base Tunnel opens for trial operation. *Modern Railways* 73(814), 84–85; ANON, 2016, The Gotthard tunnels through the Alps. *Newcomen Links* 238 (June 2016), page 20.

New narrow-gauge railway tunnels in Switzerland

A Swiss rail company, Berner Oberland-Bahn, opened a new 703-metres tunnel on its metre-gauge line from Interlaken Ost to Grindelwald on 25 November 2015. This replaces a kilometre of the earlier line including three shorter tunnels.

Another company, the Rhätische Bahn, is currently driving another new narrow-bore Albula tunnel, replacing an older one.

And in February 2016 proposals were published for a 22-kilometre narrow-gauge line to connect the Matterhorn Gotthard Railway to the Luzern-based Zentralbahn. The prospect is of an 844-kilometre narrow-gauge network connecting Luzern, Brig and Chur, this to include an 8.3-km metre-gauge single-track base tunnel. The plan is for this new long tunnel to carry both trains and high-voltage cables, allowing visually intrusive overhead lines and pylons to be removed from the landscape.

SOURCE: ANON, 2016, Switzerland: a metre-gauge base tunnel too? *Modern Railways* 73 (814), 82–83.

New Plaque for Greenwich Foot Tunnel

The Friends of Greenwich and Woolwich Foot Tunnels (FOGWOFT) members turned up at Cutty Sark Gardens on 5 July 2016 to celebrate the unveiling of an interpretive plaque for the Greenwich Foot Tunnel. They were joined by a representative of the Institution of Civil Engineers.

The ceremony was led by Deputy Leader Cllr. Danny Thorpe, whose staff had designed and commissioned the plaque. It will do a great job in explaining the history and original reasons for the historic foot tunnel. It may even answer the common visitor questions of whether this is a public lavatory or the Greenwich Observatory!

The Greenwich Foot Tunnel was built by the London County Council in 1902 as the second of a series of free river crossings for the people of east London. As such it was a major and innovative piece of engineering. The first of these crossings was the phenomenally successful – but much maligned – Blackwall Tunnel, which celebrates its 150th anniversary next year.

Both tunnels were designed by the Council's Chief Engineer, Alexander Binnie. FOGWOFT hopes we can honour both him and his tunnels – and we hope to add the, slightly later, Woolwich Foot Tunnel and, of course, the Woolwich Free Ferry.

The Greenwich Tunnel plaque is the latest in a series of projects by the Royal Borough to enhance users' experience of the tunnel. FOGWOFT have been closely consulted about all three projects.

Since the completion of the major refurbishment scheme in 2014, it would have been easy for the Borough to lose sight of the importance of this working heritage. It is to their credit that they have not; and FOGWOFT will continue to support innovative actions that improve both tunnels.

For a detailed history of the tunnel see *Subterranea* 37, December 2014.

See https://fogwoft.com/

SOURCE: Mary Mills

Proposals for an undersea rail tunnel from Estonia to Finland

The practicability of making an 80-kilometre rail link from Tallinn to Helsinki, passing under the Gulf of Finland and so avoiding a very long journey via St Petersburg is to be investigated.

SOURCE: ANON, 2016, Estonia / Finland tunnel plan agreed. *New Civil Engineer*, February 2016, page 70.

Proposed first passenger railway, first railway tunnel, and first underground station for Iceland

When in the 1930s the oldest parliament in the world, the Icelandic AlÞing, debated a proposal for a railway line from Reykjavík to Þingvellir, the scheme was rejected on the grounds that railways are 'not poetic'! Now a railway in Iceland has been proposed again, with possibly a greater likelihood of being constructed.

Reykjavik City Council has backed a proposed 47-km rail link to the international airport at Keflavik, southwest of the city. The Reykjavik terminus would be underground, below the central bus station, as would the first 12 km of the line. The remaining 35 km would run alongside the motorway. A journey time of 18 minutes has been suggested, at speeds up to 175 kph.

SOURCE: ANON, 2016, Iceland: Reykjavik Airport link. *Today's Railways Europe*, June 2016.

Tunnels for cows in the USA

Horse tunnels in Camden, London, are relatively well known. But tunnels for cows *en route* to people's dinner plates are a category new to your scribe. The idea is for movement of large animals in city areas bypassing congested roads and avoiding slowing traffic. Tunnels from railway yards to slaughterhouses, whereby cattle pass below rather than across city streets, are known at least three locations in North America.

The oldest example seems to be the Walden Street Cattle (or Cow) pass dating from 1857 in Cambridge, Massachusetts. Added to the National Register of Historic Place in 1994, this tunnel was in use for its original purpose until 1870. Cows were driven from the Fitchburg (later Boston & Maine) railroad yard to the market that served the Boston abattoirs. The tunnel is a 'brick tube' 9.1 metres long, 3.7 metres wide, and 2.7 metres high. It runs below the Walden Street overpass built in 1914.

Another example constructed in the 1870s is to be found in New York City. This was built by the Manhattan Abattoir Company to link a cattle dock at the bottom of West 34th Street with its slaughterhouse. The cattle were driven under 12th Avenue. The source cited does not specify dimensions.

A much more modern example, constructed in 1932, is also to be found in New York City, provided for the transit of cattle from the Pennsylvania Railroad's Pier 78 at West 37th Street below 12th Avenue to the block between West 38th and West 39th Street. This has a length of 70 metres. The railroad's Pier 78 was specially fitted to receive cattle from its purpose-built cattle ferries which conveyed the doomed animals from across the North (or Hudson) River. It is reported that the West 37th Street tunnel is 'probably' intact, as perhaps is that at West 34th Street.

SOURCE; LEVITT, Alan M., 2016, A tunnel for cows in New York. *Newcomen Links* 238 (June 2016), page 21.

Funding for a 300m tunnel will provide a key link between Bangor and Bethesda in North Wales

Currently the popular Lôn Las Ogwen cycle route runs for about four miles on the trackbed of the former railway line from Porth Penrhyn to Tregarth. However, due to a closed tunnel users cannot reach Bethesda without having to use a diversion.

Gwynedd Council have now secured cash to develop the tunnel which is part of the former railway in Tregarth. Work includes securing a rock at the side of the ravine, illuminating the tunnel which is 275m long and steps to safeguard users on the viaduct over the Ogwen River.

South portal of Tregarth tunnel in January 2013. Photo Paul Wright

In the last financial year £200,000 was set aside for the project, while on top of that £230,000 has been secured from the Welsh Government. Council chiefs estimate maintaining the route will cost £17,000 a year to deal with seasonal growth, weather, collecting litter and vandalism.

"Developing the tunnel and the viaduct would not only make travelling easier for visitors on foot and on bikes, but they are also attractions in themselves to be appreciated as part of the industrial heritage of the Bethesda area."

Tregarth tunnel is featured on Sub Brit web site www.subbrit.org.uk/sb-sites/sites/t/tregarth_tunnel/index.shtml

SOURCE: *Daily Post*, 23 June 2016.

Sai Ying Pun station cavern and passenger and ventilation adits, Hong Kong

Sai Ying Pun station on the West Island rail line in Hong Kong was completed in March 2015, with a 228 -metres long station cavern connected via 1,100 metres of passenger and ventilation tunnels to four entrance shafts up to 76 metres below ground level. The station cavern lies below existing buildings, with entrances in small public buildings or parks.

As a result of there being few and small locations for station entrances, the design of the station complex was dictated by its location deep below a hillside, with passengers having to traverse up to 300 metres of pedestrian tunnel to reach some exits, or take a lift 76 metres up to ground level.

SOURCE: TAM, Hon-Wing, *et al*., 2016, Design and construction of Sai Ying Pun station, Hong Kong. *Civil Engineering*, 169(1), 17–24.

New Civil Engineer's tunnelling and underground space awards

The Institution of Civil Engineers' magazine has announced its sixth Year's Awards for outstanding tunnelling achievements worldwide.

Amongst the winning projects are a 'drought-busting tunnel' bored in the USA to transfer water from a reservoir to a drought-stricken region, the Lake Mead Intake No. 3 Shaft and tunnel. The judges declared themselves to be 'in awe' at the scale of the project which had faced 'huge technical challenges'.

London Underground's Bond Street Station Upgrade won the Global Tunnelling Project of the Year Award, and London Crossrail won the Judges' Supreme Award for boring the 42 kilometres of 6.2-metre diameter tunnels using eight 1,000-tonne tunnel-boring machines between 2012 and 2015. The TBMs averaged 28 metres per day, with a record 72 metres per day for one machine.

SOURCE: PITCHER, Greg, 2015, NCE Tunnelling and Underground Space Awards. *New Civil Engineer,* 10 December 2015, page 10.

Villagers excavate 1200-metre road tunnel by hand

Deep in the Taihang Mountains, in the Hunan Province of China, lies a 1,200-metre tunnel that was dug by hand over the course of five years by thirteen local villagers. The Guoliang Tunnel was carved into the side of a treacherous cliffside in order to provide easier transportation to and from the village that sits on top of the mountain.

Villagers got together and decided to start digging the wider pathway, as previously only a small walking path existed. They sold many of their belongings, including goats, to purchase digging materials, where they then tediously carved away at the side of the cliff.

At 1.2 kilometres, the roadway is quite a feat when put into the perspective that it was carved by hand. One of the thirteen villagers, unfortunately, passed away while constructing the passage, but work continued. The final passageway was completed in 1977 and stands 5 metres high and 4 metres wide.

At the most difficult parts of the tunnel, the crew would advance just one metre every three days, making for an arduous and thankless task. One unforeseen side effect of

this tunnel is that because its construction is so fascinating, the village of Guoliang is now a tourist attraction.

While the roadway was a major step up from the previous passage, it still remains quite perilous. So you don't feel completely claustrophobic, over 30 window openings were carved into the outward face of the tunnel, giving it an interesting look from the surrounding valleys.

SOURCE: *Interesting Engineering*, 2 June 2016.

Tunnelling under the Bosphorus for a road link from European to Asiatic Turkey

Istanbul is a city divided by a narrow sea channel, the Bosphorus strait, which links the Black Sea to the Mediterranean. One part of the city is in Europe, the other in Asia. There are currently two road bridges and a rail tunnel joining the western and eastern districts. A third road bridge is in prospect, and a first road tunnel is in course of construction.

For tunnelling purposes, this undersea crossing must be one of the most challenging in the world. The geology is complex, and falls within an area subject to earthquakes. And the waterway is so deep (deep enough to make the detection of passing Russian submarines hard to detect) that the tunnel will have to be bored up to 106 metres below the sea bed.

This is to be a 5.4-kilometre-long double-deck road tunnel. It is being excavated from east to west by a 3,000 tonne TBM with a length of 120 metres. The excavated diameter is 13.7 metres. There will be 800 metres of cut-and-cover tunnels on the landward sides of the crossing.

Tunnelling started in 2014 and advanced at from eight to ten metres a day through, variously, clay, silt, sand and gravel. Flexible 'Seismic joints' are provided at two undersea locations to mitigate the effects of seismic movements. There will be ventilation shafts and toll plazas at both ends, and an administration building at one end. Opening to traffic is expected late in 2016. A third tunnel, with three road decks to carry both rail and road traffic is envisaged in due course.

SOURCE: WYNNE, Alexandra, 2016, Under pressure: Eurasia mega-project sets bar for complex subsea tunnelling. *New Civil Engineer*, February 2016, 64–68.

Whitgift Schoolboys' visit to the Kingswood Tunnel under construction, East Surrey

Paul W Sowan

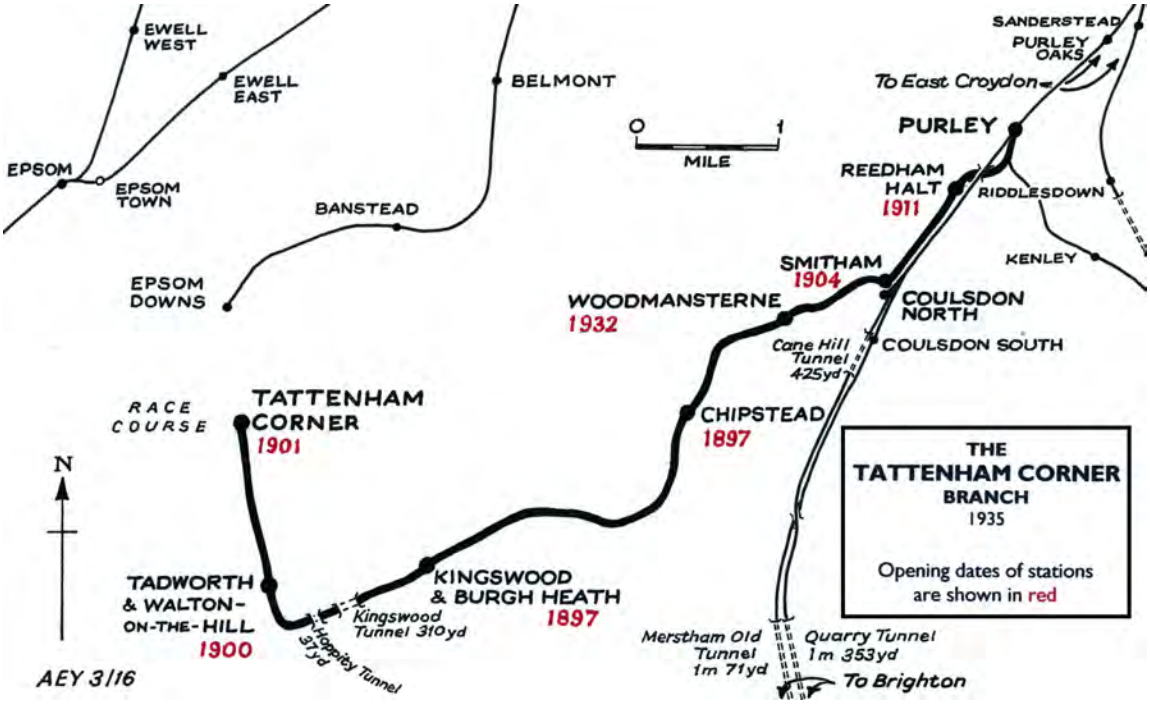
A Class 37 EMU enters the 310 yard Kingswood Tunnel with 12.21 Tattenham Corner - London Bridge service in May 2011. Photo Robert Oakes

The branch railway line from Purley in the London Borough of Croydon to Tattenham Corner on the North Downs, built primarily to serve the Epsom Downs racecourse but now largely a commuter line, was constructed in phases. A single track was opened to Kingswood, a temporary terminus, on 1 November 1897. Heavier civil engineering works were required beyond this point, notably the Kingswood (310 yards) and Hoppity (37 yards) tunnels between Kingswood and Tadworth stations.

The single line was extended through the tunnels to a station at Tadworth, opened 1 July 1900. The track was doubled the same year, the cuttings and tunnels having been made with that in view. The line, gaining height throughout its length, was completed to Tattenham Corner, where the terminal station opened on 4 June 1901.

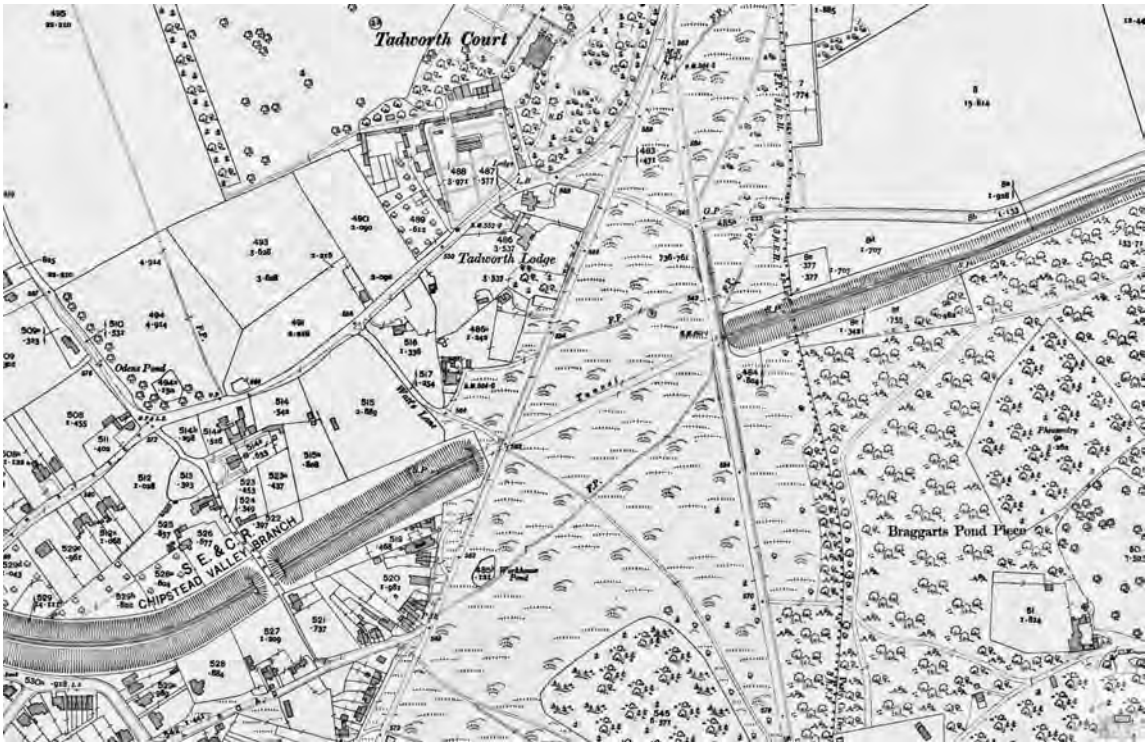
The opportunity to visit the building of the railway, including the longer tunnel under construction, was grasped by the Geologists' Association (on 2 July 1898), the Croydon Microscopical and Natural History Club (on 15 April 1899), and the Natural History and Scientific Society of Whitgift School (on 29 June 1898.)

All three excursions were led or co-led by William Whitaker [1836–1925] of Croydon, a distinguished geologist, Fellow of the Royal Society (1887), and at the time of the Whitgift excursion the 47th President of the Geological Society of London, the world's premier geological society. He was President of the Croydon Microscopical and Natural History Club for 1899–1900, which later became the Croydon Natural History and Scientific Society. He is perhaps best remembered as the author of the two editions, of 1872 and 1889, of the Geological Survey's very comprehensive and detailed Memoir on the *Geology of London*.



The published description of the schoolboys' visit on 29 June 1898 is as follows:

> On Wednesday, June 29th [1898], W. Whitaker, Esq., P.G.S., F.R.S., conducted an excursion to Kingswood. The train left East Croydon at 1.25 p.m., and after changing at Purley, we got to Kingswood Station about two o'clock. Leaving the station, we took the path by the side of the new railway line, and after a short walk arrived at the mouth of a tunnel in process of construction. Proceeding onwards overground we looked down two of the shafts, and saw the men at work digging out the tunnel, into which we presently descended by the second shaft. Here we were provided with lighted candles, and now found ourselves in what appeared to be a long underground passage, the walls of which were strongly supported by innumerable wooden posts and boards. Walking back towards the mouth of the tunnel, we arrived at a part where the walls were quite finished and exposed to view. Again retracing our steps, we got to a small passage, very much resembling, so we were informed, a gallery in a coal pit. This is the first development of the tunnel.
>
> After climbing over numerous wooden props, and trying to dodge the drops of candle grease, which were generously distributed over our clothes from the candles, we came to another shaft, from whence we reached the surface of the ground once more, after gaining a very fair idea of how a railway tunnel is constructed. Leaving the tunnel, we walked along the side of the line for a short distance, and presently came upon a "steam navvy" or "American devil" at work.
>
> This machine is used to dig out the earth from the sides of the cutting. At each stroke a huge shovel digs out part of the bank and deposits its load in a waggon hard by. When it is stated that three shovel-fulls are required to fill the waggon, and that the latter holds six tons, we got some idea of the amount of earth dug up at each stroke of the shovel. With difficulty persuading the party to leave the "devil," we walked further along the side of the cutting, with the line below us on our right, Mr. Whitaker explaining, in a most interesting manner, the formation of the more curious bits of strata as we went along.
>
> The excursion, of course, had its humorous incidents. At one time it was found that most of the party had suddenly vanished, and on looking round we discovered that they had taken possession of two swings in a neighbouring wood, where there was huge delight, which continued until one of the swings, not being accustomed to bear three people at once, gave way under the strain. After this we moved on till the top of the cutting took a downward slope and was once more level with the line.
>
> Here we turned back, and walking along the latter, had a much better view of the "wavy" strata. Each point of interest was explained by Mr. Whitaker, whose descriptions were much enjoyed. Still walking back along the line we once more arrived at the abode of that most fascinating machine, the "steam navvy." After again stopping a short time to "see the beast work," we turned our steps towards the "house on Walton Heath," where tea was provided.
>
> After making a hearty meal, washed down with unlimited tea and ginger-beer, someone suggested a game of "tip and run". The suggestion being adopted with enthusiasm, sides were chosen, and a most exciting and laughable game ensued. But all good things must end, and eventually we were reluctantly



1914 1:2500 OS map showing the 310 yard Kingswood tunnel and to the southwest of it the 37 yard Hoppity tunnel

> obliged to quit the scene of our enjoyments, and stroll to the station to catch the 7.30 train home. Some of the party cycled to Kingswood and back, while one adventurous spirit walked the whole distance. The rest, however, took train as far as Purley, where most of us, still feeling energetic, walked home, arriving in Croydon shortly before nine o'clock. And thus ended one of the most enjoyable days we remember to have spent in connection with the Natural History Society. Attendance, 23.

At a committee meeting held the next day, it was resolved, on the motion of E.G. Hay, seconded by Mr. Dodd, to present a cordial vote of thanks to Mr. Whitaker for his kindness in sacrificing his valuable time for the benefit of the Society. It was also decided, on Mr. Whitaker's approval, to nominate him as vice-president of the society.

The learned 62-year-old academic was doubtless very patient with his party of playful youngsters, even though at one point a number of them deserted the learned discourse to run away and play on swings in the woods! And the boys were fortunate indeed to have such opportunities before any such visit would be impossible to arrange on grounds of 'Health and Safety'.

Sadly, the boys' report tells us more about the swings in the woods and the tea than it does about the geology observed, it not even being noted what rock formations the cuttings and tunnel were made through. The 'wavy' strata (in chalk and overlying drift) constitute the sole recorded geological observation! Did they even look for fossils, one wonders? The civil engineering is better described, with the pilot tunnel, the unlined so

The Hoppity tunnel. This is the second shortest tunnel on the current rail network; the shortest being the 28 yard Peak Forest tunnel in Derbyshire. Photo John Law

still-supported tunnel, and the finished lined tunnel all recognisable. Boys will always be boys, and the star attraction, even outshining the swings and the ginger beer and tea was clearly the steam navvy!

Two further visits, by members of the Croydon Microscopical and Natural History Club on 15 April 1898 and by members of the Geologists' Association on 2 July 1898, were also the subjects of published reports which described the geological features revealed by the railway works. They appeared in the *Proceedings & Transactions of the Croydon Microscopical & Natural History Club* 5(1), xviii–xix (1900), and in the *Proceedings of the Geologists' Association* 15(10), 456–458.

SOURCE: *The Whitgift Magazine* 16(5), 68–69 (August 1898)

Britain's First Domestic Nuclear Shelter – Deal

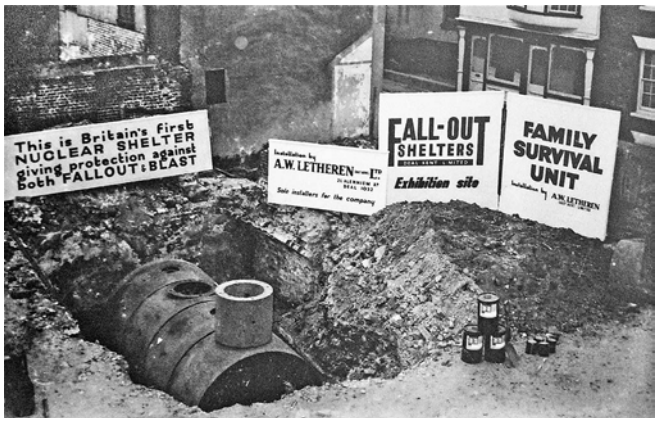
Colin Varrall

The BX model Fallout Shelter installed by Fall Out Shelters (Deal, Kent) Ltd at Pluckley. The BX is designed to accommodate 12 adults. Photo Mark Russell

During the Cold War, many countries started to build fallout shelters for their high-ranking government officials and for crucial military facilities. Plans were made to use existing buildings with sturdy below-ground level basements that could be adapted as makeshift fallout shelters.

Invest and Survive

The prototype of Britain's first domestic nuclear shelter was unveiled to the public in Deal, Kent, in March 1962, and announced with large notice boards around the site displaying: 'This is Britain's first NUCLEAR SHELTER giving protection against both FALLOUT & BLAST'. Another sign also said FAMILY SURVIVAL UNIT, while yet another gave the details 'Installation by A. W. Letheren Ltd., 21 Blenheim Road, Deal 1032, sole installers for the company'. Arthur William Letheren was a local Deal builder, born in 1922 and still living there today.



The shelter being installed on the site of the Royal Oak pub. Photo Basil Kidd

The shelter was located in the remains of a brick-built cellar where the *Royal Oak* public house had once stood, on the corner of Oak Street and Middle Street.

The pub had recently been demolished, after it had been left derelict and abandoned after World War II as it had suffered bomb and shrapnel damage.

One person who remembers the shelter being built explained: "I recall the shelter looked something like a section of concrete sewer pipe, or even a pre-formed cess tank, with an inspection hatch – dropped in a hole at the corner of Oak Street and Middle Street, almost opposite the chip shop. The next time I recall the site there were several cars parked there. I don't seem to recall there being a lot of publicity at the time in any of the local papers or on the news.

"My brother reckons that the tank was buried under the car park. The shelter had spent some time sitting on the top of the ground before it was buried as a shelter. People could go down into it, and to see what it was like inside. My brother thought he remembers people saying that it would be too expensive to dig it up and remove the shelter, so it got buried under the site when it was covered over for a car park."

Lowering the bedding into the shelter

Inside the family shelter. The handle is for closing the hatch but watch your head – it bites!

After the official unveiling of the fallout shelter to the public, the local *East Kent Mercury* newspaper printed two photographs, showing the shelter located on the site in Deal. No actual article was written with information about the shelter, and the only details provided were a notice with the following information: 'Fall-Out Shelters (Deal, Kent) Ltd. Kent Office, "Longfield", Balmoral Road, Phone Kingsdown 3. Come and see… Britain's first nuclear shelter on exhibition site at the junction of Middle Street and Oak Street, Deal (opposite Town Hall). This is a Family Survival Unit, giving protection against both fall-out and blast. This site is open to the public from 10.00 am – 8.00 pm or by special appointment.' Interested customers could phone Deal 1476. Experts would be on the spot to advise and answer any questions.

Ban the Bomb

The shelter in Deal didn't appear in the local newspaper again until a couple of weeks later when four women paraded through the streets of the town holding placards in support of the 'Ban the Bomb' campaign. If anything, this probably served as publicity for the constructors, raising the prospect as it did of an imminent nuclear war.

One of the women said, "I got the idea for the project when I came to have a look at this fallout shelter. I was struck by the absolute horror of nuclear war, and when I saw neat grass growing nearby, it showed me even more vividly what a horrible thing it would be."

A British *Pathé Newsreel* of the shelter was filmed later in 1962. The commentator introduced the one-minute film by saying: "At last there is a firm that's taking the manufacture of anti-nuclear shelters seriously, here at Deal, in Kent."

He went on to explain that thousands of the shelters had been made in America, but the executives were claiming that this was a stronger type, tested after the Soviet megaton bombs, and was claimed to be almost indestructible. Items such as bedding and other basic furniture were shown being taken into one of the two entrances. It stated that there was protection from fallout as soon as the hatch was closed above. The shelter was then stated to cost £500.


"THE BOMB"

and your protection

FACTS ON FALL-OUT

Issued by

FALL OUT SHELTERS (DEAL, KENT) LIMITED

"LONGFIELD," BALMORAL ROAD,

KINGSDOWN, DEAL, KENT

Telephone: Kingsdown 3

The front of the company brochure

One of the three local men who were responsible for the company building the shelters was Ken Burrett, who appears in the *Pathé Newsreel*. Ken appeared in a suit and was holding and showing someone a copy of plans of the shelter.

Another person who vividly remembers the shelter being built told me, "I used to work as a Saturday boy on my dad's bakery van when the shelter was being built. We always got fish and chips from the chip shop opposite [*Editor's note*, the Middle Street Fish Bar is still trading today]. I wanted to go down for a look, but dad kept saying to me there wasn't enough time, so we had to finish the round. I remember there was a long queue of people waiting to get a look inside the shelter. To me it looked extremely small and claustrophobic in there. I think back and wonder that with all fallout shelters, even in today's terms, sooner or later you have to come out, and face who knows what!"

A Pluckley Break

I had heard that at least two of the shelters had apparently been purchased by people who lived in Ashford in Kent. After some research I soon discovered images that showed what I thought could be one of these shelters. The address given for the shelter was in the village of Pluckley, which is a distance of seventeen miles from Ashford town centre.

The images were in fact taken by our own Nick Catford, who had posted the images, along with details of the fallout shelter, on Sub Brit's website. Further details on the website explain that the shelter in question was a small domestic fallout shelter located in the rear garden of a property, and had been built and supplied by Fall Out Shelters (Deal, Kent) Ltd. at a cost of £920 in June 1962. The shelter is described as the company's BX model and had a capacity for 12 adults.

The view down the ladder. Photo Mark Russell

According to the company's brochure: "These shelters are designed to withstand great stress and are virtually indestructible. They will protect their occupants against all known nuclear hazards. They are both blast-proof and fall-out shelters. Fall Out Shelters (Deal, Kent) Ltd. build every type of nuclear shelter to suit most areas and conditions. They are constructed only of the best materials and are tested at every stage of manufacture.

"Family shelters are designed for three, four, eight and twelve persons. We also design special shelters to house more than 12 persons, for factories or offices etc. Shelters are also designed for storing art treasures and valuables and in some cases we can modify a cellar to suit certain shelter requirements in fringe or rural areas. There are three types of shelter in production to suit any area in Great Britain; the types A & B both accommodate four persons.

"Their basic design is such that we can add other prefabricated sections to the unit so that it will accommodate eight or twelve persons (hence the BX at Pluckley), with additional entrance and ventilator, fresh water tank system, goods store and toilet. The length of time spent in a shelter in the event of a nuclear explosion would be dependent upon the density of the radio-active fall-out. The minimum time would be 48 hours, with a maximum of six or seven days. It is obvious then that the shelter would be your home, with all your necessities and supplies to hand. Remember that it could be some time before services were resumed again, and your shelter can hold supplies of food and water etc., for 30 days."

Fringe benefit

The 'B' type shelter was described as a 'fringe' shelter by the builders and considered 95 percent safe against nuclear hazards at 6.5 – 7 miles from ground zero of a 10–15 megaton bomb. Another selling point was that "A good family shelter will cost no more than a good secondhand car. There are no running costs to consider and of course no depreciation. It does not date, there are no survey fees to pay and the foundation and erection are included in the cost."

The surface features of the BX shelter at Pluckley. The Pluckly ROC Post is seen in the background. Photo Mark Russell

At the surface at Pluckley there are two hinged convex steel hatches and two 'mushroom-shaped' air vents. The roof of the shelter is only one metre below ground level

and the shelter is accessed by a removable steel ladder. The shelter takes the form of a buried concrete cylinder 6.6 metres long and 1.7 metres wide. A flat concrete floor divides the cylinder into two unequal parts giving a floor to ceiling height of 1.8 metres. There is an access hatch at one end which cannot be opened but it would appear to lead to toilets and a battery compartment beneath the floor.

The manufacturers' artist's impression of a fully furnished type 'BX' shelter, which this one never was, shows four double beds, cupboards and storage areas. It makes the shelter look quite spacious which it certainly isn't.

The toilets on the lower level must have been very cramped as they are shown as less than half the height of the main 'living' area. The two rotary controls for the vents protrude down from the roof necessitating a duck to avoid serious head injury, not that the beds would have left much room to walk around. Apart from some rust on the rotary vent controls and the rotary control to the lower-level hatch, the shelter is still in good condition. The owner used it as a wine cellar in the past but he found it was too damp so it is now unused. He had considered removing the soil cover and the roof to create an ornamental pond but has now been persuaded to drop this idea.

Close by the fallout shelter in Pluckley is an underground Royal Observer Corps (ROC) post, Maidstone 30, which was built just one year before the domestic shelter. It is believed that the owner of the cottage may have had a conversation with their ROC neighbours and discovered the dangers of nuclear fallout in the event of an attack and that this influenced his investment.

Sub Brit at Fawley Hill Vintage Weekend 2016

Stewart Wild

This year's Vintage Steam weekend at Fawley Hill near Henley-on-Thames was even bigger and better than the two previous occasions. The estate is the home of Sir William and Lady McAlpine who like to hold a party – always with the aim of raising as much money as possible for charity – and this year's extravaganza was to celebrate Sir William's 80th birthday.

Sub Brit, as a registered charity, was invited to attend and a dozen or so members volunteered to man a stand over two days where we raised awareness of the society, sold a few of our publications, invited folk to complete a light-hearted quiz about tunnels and generally had a good time.

There was plenty of competition: dozens of charities and conservation groups were represented, along with over fifty vintage tractors, a similar number of pre-1960 bikes and motor bikes, over one hundred classic cars (including a few very early ones powered by steam), commercial vehicles, military vehicles, fire engines and the stars of the show: dozens of steam-powered road rollers, showman's engines, steam tractors, road haulage engines, and even a Centurion-type tank. This last came in useful after rain fell on Sunday to tow out some of the road rollers that got stuck in the mud.

The central arena presented a range of attractions including displays by horses, sheep and even camels; parades of historic vehicles, a dog show, and much more. Air displays featured replica WWI tri-planes, a Spitfire and a Hurricane from WWII, and a parachute arrival by the Red Devils.

The fairground attractions included a Big Top which featured a rock concert on the Friday evening and a whole range of musical entertainment throughout the weekend including choirs, a belly-dancing display and a remarkable 80-strong ukelele band.

SubBrit stand at Fawley Hill. Photo Nigel Headley

Sir William's private steam railway was extremely popular, offering rides for a fiver, while the model railway displays and railway museum had people queuing too.

The dates for next year's Vintage Festival have already been announced: 12–14 May 2017.

For further information and pictures:

www.fawleyhill.co.uk

www.youtube.com/watch?v=3vxZOYRclW8

www.youtube.com/watch?v=gO2r5KMmZUc

Sub Brit Reconnoitres Gibraltar

Tim Wellburn

Calpe Hole generating station: two of the English Electric Fullagar diesel engines and generator sets

In March 2016, Chris Wilkins ran a pilot Sub Brit trip to Gibraltar to test whether this could be developed into a repeatable overseas study visit. Challenges include complicated and changing site ownership and key-holding; military and commercial security; continuing conservation work by the Gibraltar Government; difficult physical access to some sites; and a lack of affordable private transport. Whilst not everything ran to plan, Chris delivered an exceptionally interesting trip.

Gibraltar becomes British!

On 4 August 1704, an Anglo-Dutch 'combined operation' captured Gibraltar – nominally on behalf of Charles II of Austria, the Hapsburg pretender in the War of Spanish Succession. However, it was the King's Colours which were run up on The Rock. Article X of the Treaty of Utrecht (1713), which eventually ended the War, awarded Gibraltar to the British Crown. It was not ambiguous:

> *"The Catholic King does hereby, for himself, his heirs and successors, yield to the Crown of Great Britain the full and entire propriety of the town and castle of Gibraltar…to be held and enjoyed absolutely with all manner of right forever, without any exception or impediment whatsoever."*

The Great Siege (1779–83): the genesis of underground Gibraltar

Notwithstanding this resolute language, the Spanish attacked the Rock again in 1725–27, but it was not until the Great Siege, some half-century later, that military tunnelling became a significant tactic. In this latter siege, endured for three years, the Spanish eventually advanced their lines sufficiently for the British to be unable to bring full flanking fire on them.

The solution – proposed by the Military Articifer Sergeant Major Ince – was to drive a tunnel to 'The Notch', a protruding part of the rock face on the North Front, from where a gun could command the enemy positions. In driving this gallery, a ventilation hole was cut through the rock face – and rapidly utilized as an improvised gun position. Although The Notch was not reached before the end of hostilities, three more guns had been mounted in similar embrasures within the advancing gallery.

One of the 5.25-inch guns of Princess Anne's Battery, installed in 1956, which had a dual anti-aircraft/coastal defence role; in the background the original 18th-century gun gallery leading to The Notch. Photo Clive Penfold

St. George's Hall, excavated within The Notch

Following the Great Siege, in the final decade of the century, military engineers undertook extensive tunnelling to strengthen the Northern Defences. After this burst of activity there was a lull of some 80 years until the period 1880–1915 when the Admiralty, Army and City Council all embarked on new underground works (the civilian projects being reservoirs). The rise of Nazi Germany stimulated renewed activity: principally further reservoirs and air-raid shelters in the 1930s, and a dramatic increase in all types of military tunnels thereafter.

The intention was to be able to support the garrison of 16,000 with shelter, food, ammunition, power and medical facilities for over a year. New underground projects – reservoirs, fuel storage systems and road tunnels – were initiated post-World War II, the last being completed in 1967, by which time Gibraltar's underground network extended to some 34 miles [1].

The Royal Engineers

The Corps of Engineers was established as a military unit in 1757, being awarded the title Royal Engineers in 1787, but continuing to comprise only a relatively small group of professional engineers of officer rank. It was in Gibraltar, in the 1770s, that non-commissioned engineer soldiers first appeared, at the instigation of Lt Col. William Green, Chief Engineer of Gibraltar. Their role was formalised in 1787 as the Royal Military Articifers, becoming the Royal Sappers and Miners in 1813. Amalgamation with the Royal Engineer Officers in 1856 finally brought into existence the Corps of Royal Engineers (RE). From 1941 to 1943 four RE tunnelling companies, together with a Canadian company, were deployed in Gibraltar, working on the biggest tunnelling project in the Corps' history.

Sub Brit probes the defences

Many of us had chosen to stay at the Bristol Hotel, the wartime Headquarters of No.200 Group, Royal Air Force. Here we assembled on the Sunday evening to be briefed by Chris Wilkins and by Pete Jackson, who would lead the visits to the military tunnels. However, 'no plan survives contact with the enemy': in this case the (unannounced) docking of a Royal Navy submarine which put certain underground areas off-limits, disrupting our intended programme. The 'welcome pack' which Chris had assembled

The Itinerary as delivered

Monday 14 March	*a.m.*	*Northern Defences: King's, Queen's & Prince's Lines*
	p.m.	*Bufadero (Windmill Hill): South & West Batteries*
Tuesday 15 March	*a.m.*	*Great North Road & Calpe Hole Generating Station*
	p.m.	*Devil's Gap Battery and Hay's Level*
Wednesday 16 March	*a.m.*	*Arow Street*
	p.m.	*Lower St.Michael's Cave*
Thursday 17 March	*a.m.*	*Harley Street & Beefsteak Magazine*
	p.m.	*Free*
Friday 18 March	*a.m.*	*Admiralty Tunnel & COMCEN*

included a very useful copy of *After the Battle: Gibraltar* [2], which provided a plan of the tunnels as well as much technical information on their design, construction and fit-out.

The Northern Defences

The 'Great Siege' tunnels reached The Notch in June 1783, although the impressive St George's Hall within it was not completed for a year or two after that. These galleries have long been publicly accessible and are well-displayed, so were left for us to visit in our own time.

The Northern Defences lie on a SW–NE alignment, and comprise the King's Lines (pre-1704 and Spanish in origin), the Prince's Lines (1704–1727) and the Queen's Lines (1779–83). The Queen's Lines run beyond the King's (the two being separated by a large natural gully) with the Prince's Lines parallel to and above the Queen's. They were designed to give flanking fire across the Land Front, contributing to a defensive barrier so formidable that it was referred to by the Spanish as "the mouth of fire" (*el boca de fuego*). Their related galleries were constructed in the years immediately after the Great Siege, providing additional gun emplacements, shelters and, together with the "Communications" or covered ways which cut across the slope of the Rock, protected links between the Lines.

A WWII gun position and ranging diagram within an 18th-century chamber

On initial acquaintance, this network of Lines, batteries, stairways, galleries and chambers is bewildering, not least because of the way that the works developed, ultimately being adapted and extended to serve Second World War requirements [3]. The original galleries were generally 7 ft wide by 8 ft high, and being cut through limestone, unlined. However, the layering of centuries, and of concrete on stone, was much in evidence. Pill boxes nestled behind 18th-century parapets and blast deflectors protected passageways cut long before the invention of high explosives.

We climbed up the steep path from Casemate Square (a splendid 1817 bomb-proof barracks, conserved and turned into a vibrant city hub) to meet the enthusiastic visionary of the Northern Defences, Carl Viagas. Carl, who works for the Government of Gibraltar, explained some of the transformational work underway to restore the Rock's hitherto neglected military heritage.

The King's Lines

Ahead of us the way divided. To the right were steps leading up to Hanover Battery and Prince's Gallery, and beyond to Lower Union Communication and Gallery. We headed left, down a slope past a fine Victorian palisade gate and into Hanover Gallery (1789), the entrance to the King's Lines – and the Queen's Lines beyond. Taking a descending passageway immediately on our left, we emerged into to a fine, vaulted bomb-proof Battery (1790).

Bomb-proof Battery, 1790

Cut into the rock beyond this lay the King's Lines, a broad parapeted terreplein (platform) with a brick firing step. Various WWII accretions included a pillbox with a well-preserved ranging diagram painted on the wall. We were to find other examples of such lethal art, including some in the 1940s gun emplacements built within the galleries.

Numerous openings in the rock face led back into King's Gallery, which runs parallel to it. Entering one of these, we shortly reached the "Star Chamber" (1790). This exploited a natural cave and had served as the 18th-century tunnellers' main base. Internal brick structures and a concrete plaque revealed that the Star Chamber had also served, in 1941, as HQ for the 2nd Battalion, The King's Regiment. A long, hairpin-shaped gun ramp connects this Chamber to the contemporary 220 ft (67m) Prince's Gallery which links the Prince's Lines with Hanover Battery.

Continuing a short way northeast, we entered St Patrick's Chamber (1790), home to some large water tanks. Various other galleries radiated off, including one to an underground magazine and the extensive chambers and gun emplacements of Commons Hall (1789). A 19th-century loopholed wall defended St Patrick's Chamber from Queen's Gallery, which lay immediately beyond.

Queen's Gallery with the loopholed wall of St Patrick's Chamber visible at the start of the gallery. Photo Clive Penfold

The Queen's Lines

Queen's Gallery (1787–89) is the longest of this era, running for nearly 1100 feet (330m). A steep flight of concrete steps, Page's Raise (dated Oct 1940), led down from it to one of the Orillon Galleries, a rather crudely excavated gun chamber retaining a heavy iron gun mounting.

Further on, numerous openings gave access to the long terreplein of the Queen's Lines, with its parapet and inevitable WWII pillboxes. This was overlooked from the southwest by an armoured Defence Electric Light (DEL) position. At the end of the Gallery, a spiral staircase would once have taken us up to the Prince's Lines. This is now derelict, with very decayed concrete steps. However, the shaft dated from the 18th century, so the original staircase would probably have been wooden – and capable of demolition *in extremis*.

Page's Raise (1940) leading up to Queen's Gallery Southwest (1789)

The Prince's Lines

The Prince's Lines occupy a rock ledge, some 70 feet above the Queen's Lines. We approached these via Lower Union Communication, the steps to which we had seen at the start of our visit. This took us much higher up, to Lower Union Gallery (1789): only 232 feet (67m) long, but containing four impressive gun emplacements. These were rock-cut chambers, with upward sloping paved floors to help arrest the guns' recoil. Anti-splinter curtain rails were still in place above the embrasures.

Carl explains the Lower Union Gallery gun emplacements. Note the rail for the splinter curtain

From here, a long external flight of steps took us back down to the foot of the Retrenchment Wall and the

Prince's Lines. Although these Lines were constructed by the late 1720s, the external magazines and other defensive structures built along the ledge were mostly built in 1761 as part of major improvement works under the (then) Senior Engineer, Major William Green. The Prince's Magazine and the long bomb-proof Barracks are particularly fine 18th-century buildings, the former bearing the Royal insignia "GR 1761" (George III, recently crowned).

At the far end of the Lines there had been DEL emplacements, evidenced by two surviving sections of the lights' armoured shields. Steps near here led down to the Queen's Lines. We paused at Queen's Lookout, adapted in WWII as a Bofors anti-aircraft gun position, to admire the view of The Notch and the line of embrasures of the Siege Tunnels – with Spain beyond. This effectively marked the extremity of the Northern Defences and of our visit.

As we walked back down the hill into town, I noticed the street name: "Road to the Lines". Many people must have read this sign without any conception of the exceptional nature of these Lines, which we had been privileged to explore.

The Naval Dockyard

The strategic importance of Gibraltar was as a Mediterranean base for the Royal Navy, and it was this that required the Rock's fortification. However, the capture of Minorca in 1708 meant that until well into the 19th century, Gibraltar played a subsidiary role to Port Mahon – and, from 1800, to the major naval base of Malta. Throughout most of this period its main naval facilities were the hospital (dating from 1741) and the bomb-proof victualling depot at Rosia Bay (1799). Both buildings have survived. Most of the present dockyard infrastructure was constructed only in the decade following the Naval Works Act of 1895. This funded the further extension of the moles and the construction of three large graving docks, coaling facilities, workshops and stores – and an underground magazine exploiting a natural cave behind the harbour at Ragged Staff.

Bufadero (Windmill Hill): South & West Batteries

Bufadero Training Centre is an active 37-acre military facility located on the Windmill Hill Plateau, near the southern tip of Gibraltar. As well as providing conventional small arms ranges, its mock village, abandoned batteries and access to the Rock's WWII tunnels offer specialist training opportunities. It holds one of the two 1:600 scale models of Gibraltar constructed in 1865 to the survey by Lt Charles Warren RE (the other is in the Gibraltar Museum) and Pete Jackson used this to demonstrate the successive lines of defences devised by Victorian and later military engineers.

Pete Jackson uses one of the 1865 models of the Rock to brief the Group. Photo Clive Penfold

Our specific objectives were the South and West Batteries, although there was much else of interest, including the barracks, two demi-bastions (c.1846); the Buferado Battery Magazine (c.1855); and the Windmill Hill Main Magazine (1809 – making it one of the oldest buildings in the area). We also examined two 3.7-inch Anti-Aircraft gun positions, albeit somewhat rubble-filled, and their battery command post.

The South Battery

The South Battery was designed to oppose attack by destroyers or motor torpedo boats and comprised an adjacent pair of twin 6-inch gun positions, respectively orientated southwest and south. Emplaced in 1896/7, the guns were removed in 1906, although one gun was restored for training purposes in B Battery,

Cartridge Lift, South Battery ('B'), Windmill Hill

which continued in use until at least WWII, with a single Mark VII (Reserve) gun. Although the steps down to its magazine were somewhat overgrown, the underground works were in reasonably good condition with wall stencilling still mostly legible and cartridge and shell lifts extant – although no longer operable.

The West Battery

The West Battery is interesting for the way it has evolved, but unfortunately two of the three gun pits are now rubble-filled, and some of the large underground magazines have been fire-damaged by underground combat training.

Fire-damaged West Battery Magazine, Windmill Hill

Built in 1886, West Battery was one of twelve 9.2-inch gun batteries installed to control the sea approaches to Gibraltar. It originally mounted two Mark V guns, upgraded to Mark X guns on Mark V mountings during WWII. In the 1950s it was radically updated to mount instead three 5.25-inch anti-aircraft/coastal defence guns. This involved the construction of an additional emplacement, grafted onto the southern end of the original battery.

This 1950s emplacement is the only one which remains in good condition and fully accessible. Entry from the surface is via a passageway leading from the end of the battery into the gun pit via an underground Duty Watch Room, where the "Limber Gunner's Notice Board" is still in place. A separate ramp to the rear gives access to a generator room.

The main access to the magazines is via steps and a ramp at rear, both leading down to a long lateral passageway which appears to have been created by a concrete addition to the battery's original back wall. Behind this is another lateral passage, off which are the brick-built vaulted-roof magazines with their issuing hatches still largely in situ. At the northern end of the outer passageway is another Duty Watch Room with (rubble-blocked) access to the adjacent gun pit.

The WWII Tunnels: Specification

The Gibraltar WWII tunnels were designed to provide bomb-proof accommodation to enable the garrison to withstand a one-year siege. They therefore also had to provide for all other requirements, including power and water supply, food and equipment storage, and maintenance, laundry, sanitary and medical facilities.

In general the tunnels and chambers were built to standard specifications and procedures, developed after a little trial and error. They were not lined except at entrances and in rock-fault areas, where reinforced concrete was used. However, considerable water seepage had to be managed.

Communication tunnels were cut to standard sizes according to function, initially 8 ft. x 8 ft., with vehicular tunnels ultimately 15 ft. x 14 ft. with passing bays every 100 yards. The minimum gradient was 1:100, to facilitate drainage, with a maximum of 1:8 for vehicular tunnels.

Blast protection was provided, at least latterly, by three overlapping blast walls in pedestrian tunnels and 3-pocket blast traps at main vehicle entrances.

Accommodation and storage chambers were built to hold Nissen huts (24 ft. span), Iris huts (35 ft. span), or larger concrete-block buildings with truss roofs. Air circulation was ensured by leaving a 2 ft. air gap all round the buildings. For the same reason, grouped chambers were linked at the rear with a 'back drive' (an 8 ft. x 8 ft. tunnel). Accommodation areas had ducted ventilation and were gas-lock protected.

The chambers were sometimes excavated alongside, and open to, the communication tunnel, with standard dimensions of 28 ft. width by 100-300 ft. length. More usually, to minimise frontage, they were built in groups, at right angles to the tunnel. Standard dimensions in this case were in the range of 28-40 ft. width and 150-200 ft. length. Access was either directly off the main tunnel or from a parallel service tunnel. In either case, facing lay-bys were provided in the communication tunnel. Independent tunnel systems were built for the storage of water, oil and high explosives.

The Great North Road

The Great North Road (1942–43), like its British namesake, is a major traffic artery, linking important underground sites from Calpe Hole generating station in the north through to Maida Vale (near the old Casino) in the centre. To facilitate way-finding, significant points

along the tunnel were given memorable place names (e.g. Doncaster, Peterborough).

We entered the tunnel system at Maida Vale. From the 3-pocket blast trap substantial vehicular tunnels ran off in both directions. To our right, illuminated and straight as a die, Foss Way (named after Capt. Lindsay Foss RE) led to the numerous underground complexes, including active Royal Navy facilities, within the southeastern area of the Rock. To our left, in darkness, lay the Great North Road.

Foss Way: illuminated – but out of bounds on our visit

We headed off into this darkness and surprising warmth. Round a bend – for the Great North Road is far from straight – we came to the first passing bay, a low, wide rough-hewn chamber, receding ahead out of torch range. Some way beyond this, caged off, lay Maunsell's Winze (1943): 466 steps descending to join Admiralty Tunnel near to the Allied Command H.Q., deep in the heart of the Rock.

Great North Road: lorry passing / parking bay

After another enormous and almost flat-roofed passing bay, we reached a Brigade HQ tunnel complex. Those able to limbo through the barrier of pipes and cables were rewarded with two decaying Nissen huts and a passageway, oddly stock-piled with galvanised water tanks, which led to air (and, presumably, to the comfort of the Rock Hotel).

Doncaster Adit, a more substantial entrance, protected by two sets of blast doors, provided vehicular access to magazines and a siege kitchen. The kitchen, one of many such, was designed to feed 500 people a day, and apparently was tested and then mothballed. A curiosity was the pair of Le Creuset cauldrons still in situ.

Magazine Ramp (1944) was originally a construction entrance providing direct access to the tunnel system, subsequently modified to create a blast-trap. Construction of this ramp revealed a natural cave, named Wilson's Cave after the officer commanding one of the Tunnelling Companies. A handful of us made the slippery ascent to admire the limestone deposits in the form of shawls and flowstones.

Continuing along the Great North Road, we reached Durham Adit, a pedestrian tunnel which would have taken us out to Lime Kiln Steps. A modern sub-station is installed here. The next passing bay, rather surprisingly, contained large piles of anti-torpedo netting. Of WWII vintage, this was now used, more prosaically, for rock stabilisation.

Calpe Hole Generating Station & Hospital

Further north again, beyond a locked gate, we entered the industrial-scale cooling facility of Calpe Hole generating station. The roadway was now formed out of the walled-off, and partially roofed, side of a large chamber. This chamber was further sub-divided by a stepped wall running diagonally across it, mounting two sets of six large fan-cooled radiators. On the other side of this wall, all twelve radiators vented in a row into the corresponding long triangular space. Large steep ramps opening to daylight at either end of the chamber served as the air intake and vent.

Calpe Hole generating station: a flight of six fan-cooled radiators, set in a diagonal wall across the chamber. Photo Clive Penfold

Originally excavated in 1943 as a ration store, the generating station was a postwar facility, conceived in 1948 and commissioned by 1956. It provided back-up power for the military until 1972, being decommissioned two years later. Three massive English Electric Fullagar double-acting diesel engines and a Ruston gas turbine

The massive underground generator hall at Calpe Hole. The two English Electric Fullagar diesel engines and generator sets are seen at the back of the hall. Photo Nick Catford

were installed within an enormous chamber – or more accurately, within a substantial single-span building contained within the chamber. There is a vehicular entrance here, from Calpe Road, a little south of the Moorish Castle. Sadly, having survived so long, this remarkable and historic plant is soon to be scrapped.

As a coda to our visit, we navigated the seemingly complex geography of the adjacent Calpe military hospital. This had been an air-raid shelter before the civilian evacuation of Gibraltar, and a Victorian gun battery (three 9-inch rifled muzzle-loaders (RMLs)) long before that [3]. Evidence of its origin could be found in walled-up gun embrasures, a small armoured expense magazine and the brick vaulting and large smoke vent of the casemate. From here, we retraced our footsteps the length of the Great North Road, emerging back into the sunlight at Maida Vale.

Devil's Gap Battery

Devil's Gap Battery: twin 6 inch Mark VII guns

Our next destination was Devil's Gap Battery, located 430 feet above sea level on the escarpment above the town. It involved a stiffish climb, setting out from Prince Edward's gate to attain Devil's Gap Footpath, an 18th-century route studded with iron rings to facilitate gun haulage. We also passed a fine brick ventilation tower, indicating the presence of underground works beneath our feet.

The present battery of two 6-inch Mark VII guns was emplaced in 1902, replacing an 1878 battery of two 9-inch RMLs. Covering the Bay of Gibraltar and approaches to the harbour, it served primarily as a coastal defence and Examination Battery. In August 1917 it fired upon and sank a surfaced German submarine. It remained in commission until 1954.

Pete Jackson produced one of his magic keys and admitted us to the magazines. These were remarkably extensive, with long, spacious access and lighting passages. In the course of redecoration, they were in superb condition: even the shell lifts looked serviceable.

Devil's Gap Battery: magazines and shell lift

Hay's Level & Clapham Junction

Hay's Level is publicly open, marketed as the "World War II Tunnels". However, its presentation lacks verisimilitude, so Pete Jackson preferred to give us a private tour. Named after Lt Col. R.A. Hay RE, these tunnels lie to the south of, and at a higher level than, the galleries of the Northern Defences which we had explored the day before. Some way in, we came across a large inscription on the wall: "178 TUNNELLING COY. R.E. JULY 1940 – MARCH 1943".

Chiefly built for storage and accommodation, this complex appears largely to comprise a series of long and wide but not particularly high chambers cut parallel to the communication tunnels. In the area

of Fordham's Accommodation these were created by enlarging Liddell Union (which connects to the south with Calpe Hospital). Here the chamber, being designed to accommodate Nissen huts, has an arched roof, but the passageway running alongside it retains its original rectangular profile. Presumably this was done for reasons of tunnelling economy, but it has created a rather awkward overall cross-section. Reconstructed huts, now atmospherically distressed, show how neat a fit was achieved.

Liddell Union (1940–41) connects with Upper Union Gallery (1788) at Clapham Junction (1940), so named because from here one can access many other parts of the tunnel system. For example: Willis's Gallery (1789)

Fordham's Accommodation: Liddell Union gallery was enlarged here just sufficiently to house a parallel row of Nissen huts

Hay's Level: A more substantial chamber which appears to have contained large generators

leads back down to the Middle Galleries; the Siege Tunnels can be reached by a climb of 364 steps; and Macfarlane's Gallery (1940–41) by descending the 595 steps of Thompson's Raise (1940-42).

Jock's Balcony

From near here other tunnels lead to Willis Plateau (on which are located the Princess Royal's and Princess Anne's Batteries together with the substantial 18th-century Willis' Magazine). Sadly, we trod none of these subterranean routes. We did, however, unexpectedly emerge into daylight at Jock's Balcony (the sobriquet refers to the 4th Battalion, Black Watch, which contributed to the construction of these tunnels and were based in them). This opening in the Rock is a stunning lookout point, and provided a theatrical conclusion to our visit.

A few of us with sufficient stamina remaining then managed to squeeze in visits both to the Great Siege Tunnels and to the Moorish Castle; others no doubt retreated directly to Casemate Square for refreshment.

Arow Street

Next morning, we caught the bus to Europa Point from outside the Bristol Hotel, wishing we had a magic key to the steel doors of 300-person air-raid shelter (1939) built into the adjacent Line Wall. Arriving early, we had time to admire Dudley Ward Way, a 500-metre two-lane road tunnel built in 1963–65. Closed in 2002, following a fatal rock-fall on the northern approach road, it was reopened only in 2010.

Arow Street (1941–42), a lorry tunnel running parallel to the cliff face, was named after Lt Col. A.R.O. Williams RE. It is still within a secure military area. Entering its reinforced concrete portal we quickly re-emerged into daylight where a four-storey building occupied a rock cavern to our left. A stone plaque announced that this had been "Monkeys Cave Convalescent Hospital", a fifty-bed hospital built in 1942. The newly rendered facade was now entirely blind, but its original fenestration included an enclosed first-floor veranda which must have offered delightful sea views.

Monkey's Cave hospital façade in February 2004, before it was rendered. Photo Nick Catford

The initial section of Arow Street, just beyond Monkey's Cave Hospital

Further along Arow Street, large chambers housed a variety of concrete buildings, or had once done so. These again illustrated how neatly accommodation was fitted into the excavated space. In one chamber, we came across the rusted remains of a group of small diesel engines. To the east side of the tunnel a number of openings revealed sky and sea. To the other side, a steep, small-section winze led down from winch foundations, beyond torch range. Leading to Cormorant Cove – and presumably the hope of a waiting submarine – this was Boat Hoist (1942), or more colloquially, "Governor's Escape".

Arow Street: the remains of a truss-roofed building. Photo Clive Penfold

Before catching the bus back, we had time to visit Harding's Battery, built on Europa Point in 1877 to accommodate a 12.5-inch RML gun. The battery was renovated in 2014 and rearmed with a similar gun (originally mounted at Alexandra Battery on the South Mole). The magazine underneath the gun now houses an exhibition.

Boat Hoist - or "Governor's Escape". Photo Clive Penfold

Lower St Michael's Cave

By way of a change, the afternoon's visit was to Lower St Michael's Cave. This is one of many natural limestone caves in Gibraltar. Upper St.Michael's Cave has long been visited, latterly as an illuminated tourist attraction, but the Lower one is a sterile cave, rather more interesting – and sporting – with entry by invitation only. It was discovered in 1942 when an adit was being driven into the bottom of the Upper Cave. This was the route by which we entered it, noting the remnants of the wartime construction tramway still underfoot.

After admiring numerous speleothems, and negotiating various ropeways and rock slides, we eventually reached an underground lake, some 30 metres long, with a width about one third of that and a depth of up to six metres.

Sub Brit tackle Lower St.Michael's Cave. Photo Clive Penfold

We gingerly edged a certain way along the edge of this on the calcite ledge formed by the calcium bicarbonate-saturated water [4**]**. In view of our exertions and the elapsed time, it was surprising to learn that we had covered a linear distance of about only 200 metres.

The calcite-edged and deceptively deep lake in Lower St.Michael's Cave

Harley Street, Power's Drive & Beefsteak Magazine

Insomuch as any part of Gibraltar's non-specialised tunnel system can be regarded as a discrete entity, the Gort's Hospital – Harley Street – Power's Drive – Beefsteak Magazine complex is one such. We entered the tunnels at Gort's Hospital (named after General the Viscount Gort, Governor 1941), adjacent to the Old Naval Hospital. Unfortunately, as contractors had possession of Gort's, we were not able to visit this area so carried on to Harley Street, which lies on the same NW–SE axis just beyond it.

The Harley Street chambers contained Nissen huts providing nurses' accommodation. Some of the derelict carcasses of these huts remained in situ. Further in, the presence of two large (10,000 gallon) water tanks was evidenced by high concrete retaining walls with attached valve huts.

A gate and an abrupt change of direction marked the start of Power's Drive, which runs south from here, leading on to Beefsteak Magazine. It is (or was) possible to reach this point independently, via the Harley Street by-pass, a 1956 smaller-profile tunnel running to the south of the Gort's Hospital and Harley Street complexes. However, this tunnel is no longer considered safe. Power's Drive is another area of standard parallel chambers, mostly profiled for Nissen huts, and linked at the rear by a 'back drive'. Again, a few huts survive in varying states of disintegration.

Beefsteak Magazine: one of the large chambers; it extends as far again behind the camera viewpoint

Beefsteak Magazine: a major water pipe now runs through the access tunnel

Beefsteak Magazine, apparently named for its shape, comprises four large parallel linked chambers, the matching centre pair being longer than the outer pair. The Magazine dates from 1895 when the Royal Engineers extended and adapted the Genista cave system beneath Windmill Hill. The current access and service tunnel arrangement is complicated, in part by the route of a large water pipe, and possibly as a result of other structural alterations. Part of the complex had been used as an Urban Close Quarter Battle Range, with house doors and windows painted on the tunnel walls.

Admiralty Tunnel and the WWII Command Centre

The Admiralty Tunnel runs in a straight line for over a mile from the Dockyard to Sandy Bay on the far side of the Rock. It was built in 1898-99, as a railway tunnel, to facilitate the transport of quarried stone to the major works being undertaken to develop the Dockyard.

The Admiralty Tunnel Dockyard portal

The Admiralty Tunnel portal although heavily gated is a simple low archway in the Line Wall behind the Dockyard. The tunnel is 'single track', other than an initial bay section at the Dockyard end, where some standby generators were being stored. Numerous pipes and cables of different vintages run along either side of the tunnel as far as the Command Centre. Much of the tunnel is lined in consequence of unpropitious geology: a fracture zone, shale, and the uncemented red wind-blown Alameda Sands which overlie the limestone of the western flank of the Rock.

Admiralty Tunnel: a short bay section just inside the Dockyard portal

Admiralty Tunnel: lined and rock-cut sections, with the accretion of many generations of pipework and cabling

WWII Command Centre

In World War II, a Command Centre was constructed immediately to the north of Admiralty Tunnel, about one third of the way along it from Dockyard (below the junction of the Great North Road and Foss Way at Maida Vale). It achieved fame as the Allied Headquarters from which General Eisenhower planned Operation Torch, the November 1942 Anglo-American invasion of North Africa.

Postwar it became a NATO Joint Operations Centre, being extended to some eighty rooms. The facility was subsequently sold for use as a secure data centre and is now owned and operated by *Continent 8*. Luis Garcia, General Manager, Gibraltar, very kindly allowed us access.

The entrance to the data centre was protected by high security. Inside, we were escorted to the 'Eisenhower Room' and then to the former NATO Operations Room where maps and information on own- and enemy forces could once have been scrutinised, and indicator boards had displayed 'BIKINI' (non-specific threat) and NATO (military) alert states. There was also a plan of the Rock's tunnel systems in much better condition than that displayed at the WWII Tunnels – and much photographed by Group members.

Beyond this lay unrestored areas of the former NATO complex and, elsewhere, the banks of powerful servers which vented their hot air into Admiralty Tunnel, and thence up Maunsell's Winze to the Great North Road – which explained the 'tropical' climate there that had so surprised us earlier in the week.

Acknowledgements

Sincere thanks are due to Chris Wilkins & Mike Scott, who undertook the considerable task of researching and organising this pilot trip, and to the indefatigable

The NATO Operations Room. Another status board is located in the right-hand corner of the room

Pete Jackson MBE, 'bearer of the keys', who guided us through the subterranean labyrinth of Gibraltar. Pete is encyclopaedic on the subject and happy to share his knowledge.

Our thanks are also due to Carl and the Government of Gibraltar. Carl's work in restoring and conserving the Northern Defences, a unique part of Gibraltar's military heritage, is exemplary. Luis Garcia, Continent 8's General Manager, Gibraltar, could not have been more welcoming in accommodating our visit to one of the most secure – and hitherto secret – locations in the Rock. I am also grateful to Brian Hillman, John Cartwright and Clive Penfold for providing me with various source material for this article. Photographs are by the author, unless indicated otherwise. Any errors are mine.

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Did the Soviet Union Cold War strategists miss a trick?

During both World Wars the United Kingdom government adapted pre-existing underground spaces, often abandoned mines and subterranean quarries, both for the storage of munitions and for air-raid shelters. Chislehurst 'Caves' for example (abandoned chalk mines in southeast London) was used by Woolwich Arsenal for the storage of explosives in World War I, and (by other than Central Government agents) as a very large air-raid shelter in World War II. During earlier years of the Cold War many such places were used again, both for munitions storage and also of course as 'nuclear bunkers' on the grounds of relative cheapness (using a ready-made hole costs less than digging a new one) and ready availability. The Geological Survey of Great Britain (now the British Geological Survey) played a key role in locating and assessing abandoned subterranean mineral workings for wartime use. Chalk and limestone were often worked underground, and of course the tunnels left by the miners or quarrymen were especially numerous on the outcrops of the Cretaceous Chalk and the Jurassic limestones of southern England. Gypsum mines in the Midlands were another obvious category.

In the early days of my research into medieval stone quarrying, in the 1960s and 1970s, I became aware that I was compiling a list of, and researching, numerous places the government of the day preferred the public at large, and of course 'the enemy', not to know about! In fact, it seemed to be the case that the British public was seen by the authorities as 'the enemy' as much as the Soviet Union was, It might well be that the Russians actually knew more about our secret places than we did ourselves!

The Geological Survey of Great Britain (now the British Geological Survey), established in 1835, has ever since its earliest days mapped the geology of the British Isles, and issued huge numbers of publications which give details of, inter alia, mineral extractive sites, both those open to the sky and those worked by tunnelling. Careful study of those publications, which were and are freely publicly available, would enable the compilation of a list of sites (as I was at first unwittingly doing) amenable to adaptation for wartime and secret uses. The large state libraries in Moscow had and have, as they do in London, extensive holdings of foreign geological survey publications. And large-scale Ordnance Survey plans, published and revised from time to time from the 1850s onwards, would allow sites to be located with some precision, those having rail connections being obviously of particular interest.

Whether or not such a study was undertaken in Moscow is not clear: possibly, the Russians missed a trick!

Refuge in Great Britain

1939 - 1945

Sylvia P Beamon

A typical Anderson shelter

From the year of the Spanish Armada in 1588 until World War I, invasion had been a recurrent British dread and even in 1914 Kitchener held back two divisions of the British Expeditionary Force to guard the United Kingdom from this threat. To the complete surprise of the nation, a German Zeppelin airship raided Hull in June 1915 killing twenty-four people – no real preparations had been made against attack from the air.

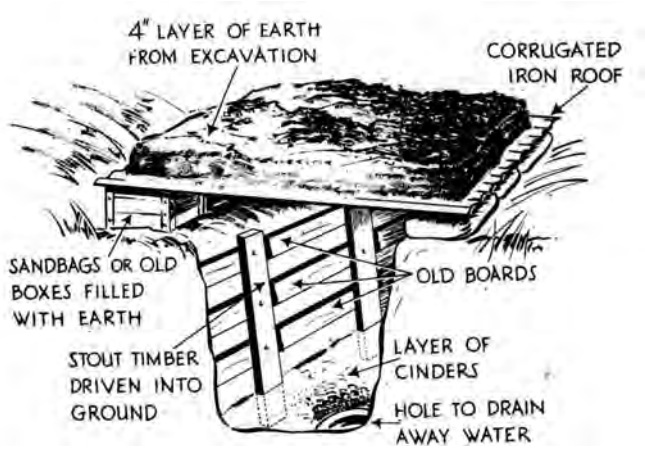
This event precipitated bomb-proof shelters to be constructed for the first time in all the major cities. After 1918 the long-standing British fear of invasion was dispelled; not even the coming of Hitler to power in 1933, with subsequent rearmament, failed to revive it, for Britain's attention as the decade wore on was fixed not on the German army, but on its air force.

Bombproof shelters

With the menace of war some far-sighted architects and builders began to incorporate air-raid shelters in their plans and structures. In the *Architects' Journal* for February 1938, it describes flats in Exhibition Road, Kensington, London, built to include a sub-basement bomb-proof shelter with two exits in case of emergency, plus if the case arose, emergency lighting, sanitation and ventilation which could be introduced at short notice.

In 1938 the Home Office Air Raid Precautions Department prepared a pamphlet on garden trench shelters which they maintained provided excellent protection for up to six persons except in the event of a direct hit. Various other literature and advice for the individual was issued, and in 1940 in *Your Home as an Air Raid Shelter* we read:

> "The simplest kind of garden shelter is an open trench which will give you complete protection against bomb splinters and very good protection against blast. Covering it over with earth will improve the protection against blast and also keep out falling splinters of anti-aircraft shells. A trench shelter needs materials such as timber and corrugated iron to hold up the earth covering and also, in most soils, to prevent the sides of the trench falling in. Suitable materials are not easy to get at present, though you may find them in your garden or outhouses."



Another leaflet appeared stating that there should be a head cover of 5 inches of concrete or 18 inches to 24 inches of earth.

> "More earth should not be used, because in the event of collapse, the occupants of the shelter might be so deeply buried as to be unable to extricate themselves. Trenches should provide not less than 6 feet of head room and should be fitted with seats. They must be lined with strong materials to prevent the walls from collapsing, and should be provided with a form of floor covering, such as duckboards or shingle. Arrangements must be made to drain away any water which may seep into the trench."

Trenches fell out of official favour well before the Blitz began: the supplies of lining materials were erratic and they were often impossible to keep waterproof. Yet these structures remained popular with the public who felt safer even just a few feet underground than in surface shelters.

A consolidating circular was published in 1942 for it was found that the precast concrete linings, with vertical side-members fitting into horizontal top-members, were relatively vulnerable and should not have been used unless strengthened. Although trench shelters were immune from danger by splinters, they were very exposed to ground shock. Their efficiency depended on how far they could withstand the forces and movements before collapse. The effect of ground-shock is nearly always to push in the sides while at the same time the roof tends to be lifted.

Other information was available for those people who did not wish to leave their homes to seek shelter elsewhere. A refuge room below ground level, preferably in a basement or semi-basement, was advocated. If a basement was not available, then a ground-floor room should be chosen before one on an upper floor as it provided greater overhead protection. A small or narrow room was to be preferred, because in the event of part of the house collapsing from a very near explosion, the roof or ceiling over it would be more capable of resisting the fall of debris.

It was suggested that a coal cellar under the pavement or under a yard at the back of a house would make a very good shelter just as it was, but if possible there should be an emergency exit. This could be provided by enlarging the coal chute or if you lived in a terrace, making arrangements with your neighbours to open a crawl hole between cellars.

Local authorities often strengthened basements: a leaflet *Provision of Air-Raid Shelters in Basements* was issued in 1939 showing a variety of designs. In Pimlico, London, 8,000 coal cellars were cleared and strengthened. They proved to be excellent shelters but presented one problem: how to stop the occupants from 'tapping' the mains to provide free power for electric fires. Protecting people in flats was more difficult, so boiler rooms, basement storerooms and downstairs corridors were pressed into use.

Restaurateurs in London who had basements used their initiative by advertising for customers in the manner of 'Dine and Sleep Here' – a night out really meant a night out! After the dinner and dance, the customers slept in rows on the ballroom floor. The more fashionable restaurants, for a small extra charge, provided customers with a bed including a mattress, pillow, blanket and clean sheets.

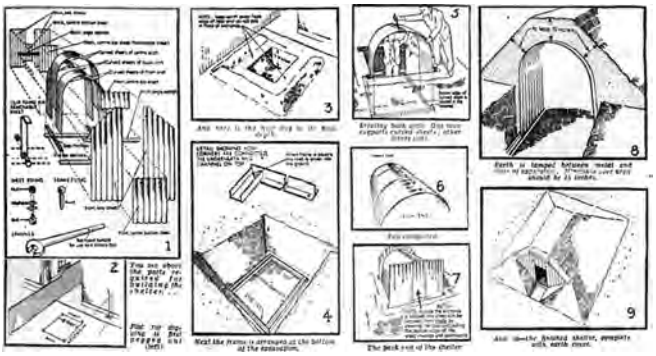
Government shelters for each home

The Anderson shelter, named after the first Minister for Home Security, Sir John Anderson, was a masterpiece of cheap and simple engineering designed for the amateur to erect. The two million kits, which the Government gave away free by the start of the Blitz in the autumn of 1940, represented an unprecedented investment for the protection of the more fortunate sections of the working class.

Anderson shelters being delivered

The shelter was made of high-quality galvanised steel and corrugated for strength. Two curved walls met in a ridge at the top and were bolted to stout rails with ½ inch Whitworth nuts and bolts, not fitted into holes but into slots so that it allowed for slight errors of fitting. There were various sized panels, 'straights' and 'smalls' besides the 'curves', but all were two feet wide. In some cases a different combination of panels was available according to the size of the family.

The erection, after delivery by the municipal authority, was a communal effort by neighbours who dug a pit 3 feet deep, placed the corrugated iron in position and bolted it together, then finally covered it with 15 inches of earth on the top, and 30 inches thick at the sides and back as it was the earth covering that gave the greatest protection. The entrance was merely a gap in the front panelling over which a sack was hung in wintertime. However, it was protected by a steel shield and an earthen blast wall, no more than 15 feet away. Government advice was to take a bottle of clean water with you, also tinned food in case of being buried, and a candle in a flowerpot to give warmth.



In order to try and obscure the unsightly humps in their back gardens, many residents covered their Andersons with flowers, marigolds and nasturtiums being popular, whereas in the horticulturally minded borough of Chelsea, radishes, carrots and lettuces were more in evidence.

The standard-size Anderson would protect up to six people against practically anything but a direct hit. Originally it had been planned as a shelter for erection inside a small working-class home, but technical objections had ensured that it became an outdoor shelter. Unfortunately, fewer than a quarter of the public had a garden. A steel shortage led to the falling off, and eventually to the cessation, of the production of these shelters.

At the end of May 1940, the Government was compelled to act drastically for it had been reported that of the two million Andersons issued free, there was evidence of wastage. Large numbers had not been erected and the components were lying around rusting. An order was issued to the public under Defence Regulation 23B either to erect them and cover them adequately within ten days or to inform their local authority why they had not done so.

If a householder genuinely was incapable of erecting his shelter then the local authority was to do it for him, otherwise the authority was to collect the materials for redistribution or storage. Human nature being what it is, those with Andersons were reassured as to their efficiency and strengthened their confidence in the Government's measures for protecting the populace.

Surface shelters in Fan Street, Liverpool

Surface shelters

In March 1940 the Government had turned to a new type of brick and concrete surface shelter – a communal shelter designed to protect some fifty residents from a single street or block of dwellings. Children on their way to school during a raid, if it seemed quiet, would run from one shelter to another whilst their gas masks in boxes bounced on their backs.

A smaller version of what was to become the familiar in street shelters appeared in some back gardens to become known officially as 'domestic surface shelters'. Most were of the size of Anderson shelters, but some could house up to twelve people, and were often built in groups for mutual protection, with two entrances in different gardens.

At schools where they had playing fields as well as playgrounds there were two types of shelter; the 'longbarrow' form when two-thirds was constructed below ground and the remainder turfed over with entrances at either end. Within, bunks lined the walls (they were little used in our particular area and were possibly for emergency only in the event of children being unable to return home after the day's schooling).

A school shelter

The brick-built above-ground shelters were used daily; inside, the walls were surrounded with uncomfortable wooden slatted seats on which the young children sat for hours. The lighting was exceedingly poor, teachers taught the best they could under the circumstances but reading and writing was virtually impossible.

I remember we were read to, made model men from acorns and matchsticks, or doll's house furniture from horse chestnuts, when in season. From time to time school lunch had to be served in the shelters which created problems for the younger ones because no tables were available and plates had to be balanced on their knees; if the menu included watered-down soup or custard, the results could be rather disastrous.

Indoor protection

The Morrison shelter, named after Herbert Morrison, the second Minister of Home Security, was introduced in the autumn of 1941 and was for indoor use by the average family to sleep under at night or to scramble beneath when the siren wailed during the day. It was constructed of a steel tabletop on four supports and could also be two-tiered. Wire panels which formed the sides and end could each be detached separately. It was designed for erection on the lowest floor of a house not more than three storeys high.

The Morrison was supplied free to people earning up to £350 a year and on sale for £7 for those earning more. Some people had both a Morrison and an Anderson shelter, but usually it was one or the other.

Morrison shelter

Besides the aforementioned forms of protection, basements of public buildings, church crypts, tunnels and caves were all brought into service. Large numbers of people used the platforms of underground railway stations in London, and late at night and early in the morning families could be seen lying huddled together. One of the two tunnels between Holborn and Aldwych was quietly closed down and reserved as a refuge for members of the Cabinet and the War Office. In frequent use too, were parts of the Post Office Underground Railway.

Southwark in London was particularly fortunate in having

a ready-made deep bombproof shelter within its area. The abandoned section of the City & South London line to King William Street, with the addition of eight staircases, provided the borough with a shelter at a fraction of the cost which would have been incurred if the tube had not been available.

Canteen in the shelter in the basement of Dickens & Jones department store in London in September 1940

Sheltering at Aldwych station

One of 9 entrances to the Southwark deep shelter in Marlborough Yard

Railway arches were chosen by many to shelter under for they 'looked' secure enough. The most infamous of all London's shelters, because of the appalling conditions, was found under the Tilbury Railway arches at Stepney. Part of a complex of cellars and vaults had been taken over by the Borough Council as a public shelter for 3,000 people but the whole area including the unofficial parts became occupied by as many as 14–16,000 on certain nights.

Sheltering in railway arches

Tunnels in the chalk

In 1940 the town of Ramsgate, being situated on chalk, had the only complete system of deep shelters in Britain, for engineers were able to tunnel 60 ft below the ground. It was here that the only signposts in Britain remained to show the people in the tunnels the way to different parts of the town above.

At the time of World War I, the Caves at Chislehurst in Kent, with tunnels cut in the chalk, came into prominence as a great and important storehouse for ammunition. Change of use occurred in 1939 when the caves provided the finest and first important air-raid shelter in Britain. People from London were able to obtain shelter for the first year of the war as guests of two public-spirited gentlemen, after which it became a Government project and during the worst of the raids was the nightly home of some 15,000 people.

Organisation became necessary, electric light was installed throughout the caves, and because of the number of people, the atmosphere was warm, healthy and comfortable. Every amenity of a large town was provided, including a church, cinema, shops, dance floors and a gymnasium, and the canteens provided over 300 gallons of tea per night. Sanitation and washing facilities were installed as well as adequate hospitalisation in case of emergency.

The church in Chislehurst Caves. Photo Nick Catford

Eventually bunks superseded sleeping on the floor, and so comfortable did the residents become that many were actually reluctant to leave when the need had gone. Travellers on the railway from the London termini would frequently see notices at the stations warning intending travellers that **The Caves are FULL – No room for newcomers.**

Certain caves at Dover were rented by the local municipality and adapted for use as refuge and schemes were also made, but not finalised, for shelters at the Blackheath Cavern and beneath Bostall Woods at Woolwich.

Government views on deep shelters fluctuated; when in favour some local authorities took advantage of the situation. Thus early in 1941 Surrey County Council, for example, began to bore five tunnels in the chalk of the North Downs – see *Subterranea* 33 (Sept 2013), p.39.

Steps were taken to sub-divide and strengthen the roofs of caves cut in a sand bed in Nottingham and used for shelter since the start of the Blitz. Government favour diminished as early as February 1941. Conditions in some tunnel shelters – notably those of Ramsgate – were described as the equivalent of a 'gipsy camp' and revived fears that widespread deep-shelter mentality might develop.

From the Consolidating Circular of 1942 it was realised that large railway-arch shelters had a high calamity risk, especially where they were in close proximity to stations. Adequate partitioning into groups of not more than fifty persons was therefore essential.

The partition walls had to be of reinforced concrete or reinforced brickwork; and where they were not carried up and bonded into the roof, they were to be strengthened against overturning by buttresses or crosswalls. Existing shallow tunnels (e.g. unlined tunnels with less than 40 feet of cover in good chalk, 25–30 feet in sandstone or 20 feet in hard limestone) had to be treated like railway arches and sub-divided by heavy baffle-walls. Any shallow sections of an otherwise deep shelter were to be isolated by baffles from the other sections with adequate cover.

People outside the danger area, and those within who earned too much to qualify for a free shelter, often built their own. Some resourceful ones had deep dug-outs constructed in their gardens which they furnished with bunks, oil stoves, candles, emergency rations, tables and chairs; in a few there were carpets on the floor, books and periodicals on shelves and even a picture or two on the walls.

An example constructed by a more affluent member of the community existed at a country house where protection was provided adjacent to the house for upwards of thirty people and apartments were included for the owner, staff, together with a kitchen and food store, tool rack, lighting and air filtration plants, first-aid equipment etc. This shelter was partially excavated into the rock and built on a 6-inch sand cushion, with the walls and roof being of reinforced concrete.

'Down the hole'

If the form of shelter allocated did not seem to be adequate, some people looked elsewhere for protection. In my own household, the doctor informed my parents that if they continually took me into the outside Anderson shelter, I would die of pneumonia.

My parents' home in Edgware, Middlesex, is situated on the side of a hill and during its construction piles had been erected at one side to support the foundations of the house. Between the piles there was a gap of approximately 2 ft 6 in by 3 ft and the height 6 ft. As my parents had actually watched the house being built they already knew of this space beneath the back living room.

My father cut a trapdoor in the floorboards and found it to be dry beneath. He made a set of wooden steps, wired up the area for electric light, an electric fire and radio, and curtained off sleeping accommodation for the family. From then onwards it was a great success and when there were bad spells of air raids, my Uncle, Aunt and their two children (who lived nearby) also came to sleep with us 'down the hole', as it was referred to.

My father cut a second trapdoor in the hall of the house where it was too narrow to be utilised as living quarters but could be used as an exit in an emergency. Both trapdoors were covered over by mats when occupied below so that in the event of invasion there was some form of a hideaway, for a cellar was not in the house design.

When the house was sold in 1977, three of the author's four children, and her parents, made our last descent 'down the hole' to see it as it was when used as a shelter in the war

A similar idea was put into operation under an older type of property in the same area. The son of the household took up the floorboards in the living room to find a gap of 18 inches between the boards and the subsoil which was clay. He dug into the clay and created a shelter of approximately 7 ft long and 5 ft wide, with a height of

6 ft. The floor was concreted over and the sides were brick-lined. In the top courses of the bricking which rose just above the subsoil, air bricks were inserted or one or two bricks were omitted. Overall was laid a layer of wooden strips to prevent dust falling through the overhead floorboards.

Access was by a trapdoor in the floorboards and a short wooden ladder. There was enough room for two bunks either side of a narrow gangway, and to make it appear more attractive the far end was decorated in the style of a Moorish window looking out into the night sky with the moon and stars shining. After the war it was used for storage.

All the aforementioned shelters were deliberately created or were permanent fixtures, but not to be forgotten is that when danger threatens refuge is sought in the most unlikely of places, for example, beneath a sturdy table, perhaps under the stairway or even actually in a cupboard.

Man's instinct is for protection and the involuntary action which takes place may not in a sense be the most sensible from the point of view of physical safeguarding, but is in effect an act to cut off the visual or audible threat thereby giving him the feeling of safety.

Make your own atom bomb

Albert Einstein [1879 – 1955], whose first area of specialism was refrigeration, proposed that mass and energy are inter-convertible according to the well-known formula $E = mc^2$, where E represents the energy released when a mass (m) is completely destroyed, c being the speed of light which is a huge number however you look at it. He went on to calculate that nuclear fission would be possible for certain kinds of atom, notably uranium 235, a naturally occurring isotope of the radioactive metal, forming 0.7% of the metal as found in nature, the rest being the relatively harmless uranium 238. The United States and Great Britain jointly developed the first atom bombs during World War II (dropping two of them on the Japanese cities Hiroshima and Nagasaki). After the war, all research and development of fission bombs temporarily ceased, and in January 1946 the USA had just one deployable bomb (and the British none).

As there was, as the Cold War got underway, a ban on UK / USA collaboration on nuclear weapons development, the British had to design their own version when, in 1947, the British decided to create their own fission bomb.

The scientific principles of nuclear fission are well enough known, and now taught in secondary schools. The knowledge is harmless enough as schoolchildren, and indeed most countries, could not command the vast resources and engineering skills required to isolate uranium 235 or to manufacture plutonium 239.

A paper by Jonathan Aylen makes the point that engineering problems also had to be solved, some of which he explains. The first British atomic bomb, Blue Danube (a plutonium bomb), was created and 'deployed first, and tested later': in fact Blue Danube was not a single design, but a continuing sequence of modifications in the light of a succession of problems.

Designing the engineered shaped charges of conventional explosive surrounding the core and the circuitry required to be robust and precise enough to compress the fissile plutonium core symmetrically

Blue Danube

was especially challenging: intriguingly, part of the solution to the robustness problem was supplied by a Barnsley firm whose usual occupation was making hot water bottles!

Work on the bomb actually commenced and plutonium manufacture was started in 1946 before the Government go-ahead was given on 8 January 1947. The first bomb was delivered to RAF Wittering Bomber Command Armaments School on 7 November 1953. Development and manufacture were dispersed between Government and commercial bodies around the country, with very few people ever seeing the 'whole picture'.

Some aspects of design are of course still classified, presumably including calculations of critical mass in relation to core design and isotopic composition. Another unknown is the 'shelf life' of the cores, which presumably inevitably deteriorate over time and have to be reprocessed and the material reused at intervals.

Of course, this whole scenario was eclipsed by the development of the even more awesome thermonuclear fusion or H-bomb.

SOURCE: AYLEN, Jonathan, 2015, First Waltz: development and deployment of Blue Danube, Britain's postwar atomic bomb. *International Journal for the History of Engineering and Technology* 85(1), 31 – 59.

Catforth ROC Post - The Post that Moved Twice

Mike Norris

The ROC post that never existed adjacent to the ROC 21 Group Control at Preston. Photo Andy Hebden

The original Great Eccleston Observer Corps surface post was located on the outskirts of the village of the same name and opened in December 1937. At that time it was designated L.1, being in 7 Group reporting to Manchester. After WWII, the ROC post became part of 21 Group and was redesignated G.3 in November 1953, 21 Group at that time being based at Lancaster Castle. The post was resited in August 1962 to a location on the south side of the former Royal Naval Air Station (RNAS) near the village of Inskip, north of Preston.

This airfield opened as HMS Nightjar on 15 May 1943 for the training of anti-submarine and two-seat strike crews and was popularly known as one of the 'stone-frigates'. The station was paid off and decommissioned on 2 July 1946, becoming a major RN radio station on 12 January 1959; it was recommissioned as HMS Inskip in 1966. Nowadays it is run by the Defence Communications Service Agency as Radio Services Inskip, and retains its worldwide communications function for all three services

The underground ROC post was opened at HMS Inskip in May 1963, changing its name at the same time from Great Eccleston to Catforth; it was designated H.3 within Group 21 from October 1968 – by this time the group control was based at Goosnargh. In the 1960s it formed a cluster with Weeton and Fleetwood. Weeton post was originally named and located at Blackpool until 1964, when it was resited to the army camp. Weeton was closed in October 1968 as part of the major reorganisation of the Corps.

Leading Observer Fred Morris emerging from the post – the FSM probe cover is to the right, the masts of the radio station are visible in the background as is one of the former hangar buildings. Photo from Fred Morris

It was a difficult post to gain access to, as it was very close to the 22-yard firing range and on one exercise the crew were prevented from reaching the post for some time as there was a shooting competition underway. These issues no doubt contributed to its selection for closure! The crews also believed that this post had a greater protective factor due to the extra lead on the roof.

Catforth post was later clustered with Forton and Longridge, the latter being the master post. By the time of the ROC stand-down there were two clusters on the Fylde: Fleetwood and Lytham (30/31 posts), then Longridge and Catforth (35/36 posts).

Fred Morris

There seem to be few pictures of the Catforth post above ground, mainly due to its proximity to the wireless station, with special instructions banning photography. The crew gained access to the post through the navy site, eventually becoming well-known to the staff at the gatehouse. Chief Observer (C/Obs) Fred Morris spent most of his Corps time at this post, being transferred here in April 1968 until March 1984. Fred was a long-time member of the ROC having joined in 1952, and being awarded a medal and two clasps for his service.

Chief Observer Jack Pollitt and (then) Leading Observer Fred Morris enjoy a brew on a fine sunny day; the GZI is just visible on the right hand side of the picture. Notice the uniform, where the rank badge is sewn to the jumper rather than the later ribbons on the epaulettes. Again a radio mast is just visible in the background and on the extreme left a white building which is the site main building. We are lucky this picture was taken; it was against the rules at the time. Photo from Fred Morris

One of the modifications Fred made at Catforth was to alter the vent on the monitoring room door. If the hatch was open, a draught would blow straight down and across your feet. The floor of a post is not the warmest place even without this, so he made a deflector to send the air into the room. Another one of those little things many crews did to help make life more comfortable and it also latterly helped confirm the door's origin. Added to this were things like pieces of carpet, which Fred remembers came at one time from his mother-in-law's bedroom, and of course pots and pans to enable hot meals to be made.

Another item which made the post unique in this area was the installation of the Luwa Air Filtration system, a manual system where the observers had to wind the handle for several minutes at regular periods. Fred recalls that they only 'closed down' the post once and used the air system for one night of an exercise; after that an order came down that they must not close the hatch lid when anyone was inside – early Health and Safety raising its head! (Note from the editor – The Luwa Air Filtration system was experimental and fitted towards the end of the post's life. Only a few posts had this fitted, examples are on display at Hack Green, Newark Air Museum and Newhaven Fort. For more photos see Cranleigh post on the SB website).

ROC Stand-Down

Stand-down came on 1 September 1991 and marked the start of the post's second relocation – well at least its fixtures and fittings. Within a couple of years of stand-down, former C/Obs Tony Snape, whose full-time job was working as a Display Technician for the Lancashire Museum Service, had been asked to put something together to support a Volunteers' exhibition and was instrumental in ensuring the Corps was represented.

The exhibition ran from mid-1993 through to 1994 at the Museum of Lancashire (MoL) and focused on uniformed volunteer organisations; it included Victorian Rifle Volunteers, Sea Cadets, WRVS, Scouts and of course the ROC.

The surface features of the recreated post in the Museum of Lancashire, taken from the viewing gallery in 1993; unfortunately the lighting was not good, being intended to light the floor of the hall rather than the top of a post. The FSM dome, hatch and GZI are all visible as is the artificial grass forming the roof of the post. The Sea Cadets display can just be made out in the background. Photo John Gedge

Tony had the knowledge of what was needed and where it might be located so after obtaining permission from the MoD he went to Inskip and duly gained access to the post. Unfortunately he did not have a key to the padlock, but the staff at Inskip were more than accommodating in cutting it off for him! Some of the components, for example the hatch and counterweight, required the concrete to be chipped away, not an easy task in the days before modern portable power tools.

He also removed the louvered vents, the top of the Bomb Power Indicator (BPI) pipe and liberated the mount for the Ground Zero Indicator (GZI). He spent quite a few hours sawing through the Fixed Survey Meter (FSM) pipe, which was not just a drainpipe as it had been nicknamed in the Corps. This accounted for all the above-surface features.

Inside the post both doors were removed along with their frames; the table, cabinet and wire runs were also removed. Some of the other interesting fittings that Tony removed were the air filter, which took quite a bit of getting to the surface, needing a rope and winch to get it out. In addition he recovered all the pipe work, which included the FSM flange used to secure the probe head either at the top of the pipe, or in its shielded position part way down the pipe. Again this needed liberating from the concrete. The BPI pipe work was somewhat easier as there was a union to disconnect it. Even the sump pump and grating were saved.

Marie Celeste

The equipment and bunks and other removable items had all been removed from Catforth at stand-down, so Tony visited a couple of other posts to see if anything could be found. After visiting Chorley he went on to Forton where he was surprised to find that it was like the 'Marie Celeste' – everything was just as the last crew had left it, including paperwork, bunks, GZI papers and even the satchel for the GZI papers. Needless to say these helped to furnish the finished display.

Apparently most of the post bunks were sent out to the Gulf following the incursion there, because the supplied beds were not fit for purpose. Following the removal of the fittings, the Catforth site was bulldozed and the monitoring room smashed in and buried, removing all trace of the post.

Having been in the same crew as Tony and worked with him on exercises when he was triangulation supervisor, I knew how fastidious he could be. So this eventually led to an excellent display where he created the mock-up monitoring room and completed it with the surface features. He even added artificial turf to the surface to complete the illusion. All the ground-level items were visible from the museum's gallery.

The biggest problem was what to put on display, in order to keep the items safe, as the museum is next door to HM Prison Preston and the visiting partners and wives would often leave their offspring in the museum while visiting! A nice touch of Tony's was the appearance of cutting through the concrete wall of the operating room so visitors could gain access to its interior without having to come down the ladder. In fact the shell of this monitoring room is still visible within the museum today, although it now acts as postwar 'prefab' house, but is still possible to see where the shaft and toilet were.

The recreated post at the Museum of Lancashire in 1994 – the hole which Tony created through the 'concrete' wall can be seen to the right, as can the sign to the viewing platform. The Luwa air system is in the centre of the picture, its filter in the by-passed, i.e. the normal position. The post office termination and test box are in front of the observer along with new style teletalk. The later type of FSM meter is shown buried in the desk, with a strap over it to prevent theft! Photo Mike Norris

Following the closure of the exhibition the items went into store for a few more years. They had not been accessioned by the museum and were still noted as the property of Tony Snape. This could have spelt disaster as one of the museum keepers wanted a clear-out and had ordered a skip, with some of material being consigned to it, along with some rather expensive display cases, but that is another story.

Preston Control

Fortunately the tale takes another twist, when the former Sector and Group Control bunker at Preston (21 Group – Goosnargh) came up for sale in 2004. A veterinary practice had bought the control and its surface training buildings ten years earlier, following stand-down. Having established the business, they discovered they were only using the surface premises and had little use for the bunker itself; as separate access could be made available, they placed it on the market.

The former water tank room, in the control bunker in 2009. Evidence of modification to prepare it for its new role is clearly visible, including rerouting of pipework and bricking-up of the apertures to the adjoining room. The pipe visible at 45 degrees is where the post's toilet room will eventually be located. Photo Mike Norris

The first potential buyer pulled out of the sale leaving the bunker on the market until 2005. The next client was keen to find out about the bunker's history. In February 2007 he contacted my wife Elaine, who was then the Royal Observer Corps Association (ROCA) Preston contact. We were able to provide him with some background information and to arrange contacts to other members within the former 21 Group. This culminated in a visit to the former control in November that year, whilst it was still being refurbished for its new role.

This is a general view of the recreated monitoring room, looking toward the shaft and toilet in 2014. The door shows Fred's deflector modification, the sump pump is visible beyond. On the wall is the Luwa filter system, shown in its 'Active' condition – 'Pete' enjoys a cigarette! The post radio was never issued to Catforth but is displayed in the correct location. Photo John Gedge

Around this time Tony Snape was being pursued to remove his artefacts from storage at the museum and after contacting our group archivist John Gedge, we were able to get the post materials transferred to their third home. At a meeting in June 2009 the bunker owner was able to show us the former tank room which would contain another recreation of the post monitoring room.

Within six months most of the post had been recreated including the surface features which were located outside the bunker some fifty yards from the entrance. It was the discovery of this and its subsequent posting on the SubBrit forum titled 'ROC Mystery – a new post at Goosnargh' which prompted this article.

Tanks for the memory

The surface features include a fenced area and gate, the hatch and vents, FSM dome and BPI baffle. The hatch and vents were created using concrete and shuttering much like the original, although there are only footings below ground and definitely no tunnel to the former control. The ladder was recovered but was used for the internal representation which was reconstructed inside a former water tank room in the control bunker.

The tank, fortunately built in panels, was easily removed and the plumbing adjusted so that a post-sized room could be constructed, with space for the shaft and toilet. The toilet has the original door and Elsan, the shaft sports the ladder and sump pump, although no actual sump due to the concrete floor of the bunker. Inside the monitoring room many of the original features are on display and it does provide a space for additional items to be shown, for example the post radio, which 36 post itself wasn't equipped with.

We are very fortunate to have an owner of the bunker who has welcomed the ROCA and maintained an interest in the heritage of the building, providing a valued location for items which would otherwise have been lost. Added to this the ROCA have had the privilege of being able to hold meetings in the bunker once or twice a year. The highlight of which was a beacon lighting event in June 2012 to celebrate the Queen's Diamond Jubilee, when Fred Morris lit the beacon standing on top of one of the bunker's vent stacks, in a 'Fiery Fred', beacon-lighter pose, the emblem of the Corps.

Thanks to:

Former C/Obs Tony Snape

Former C/Obs Fred Morris

Former C/Obs John Gedge

Michaela Jackson-Smith and Stephen Ball (Lancashire Museum Service)

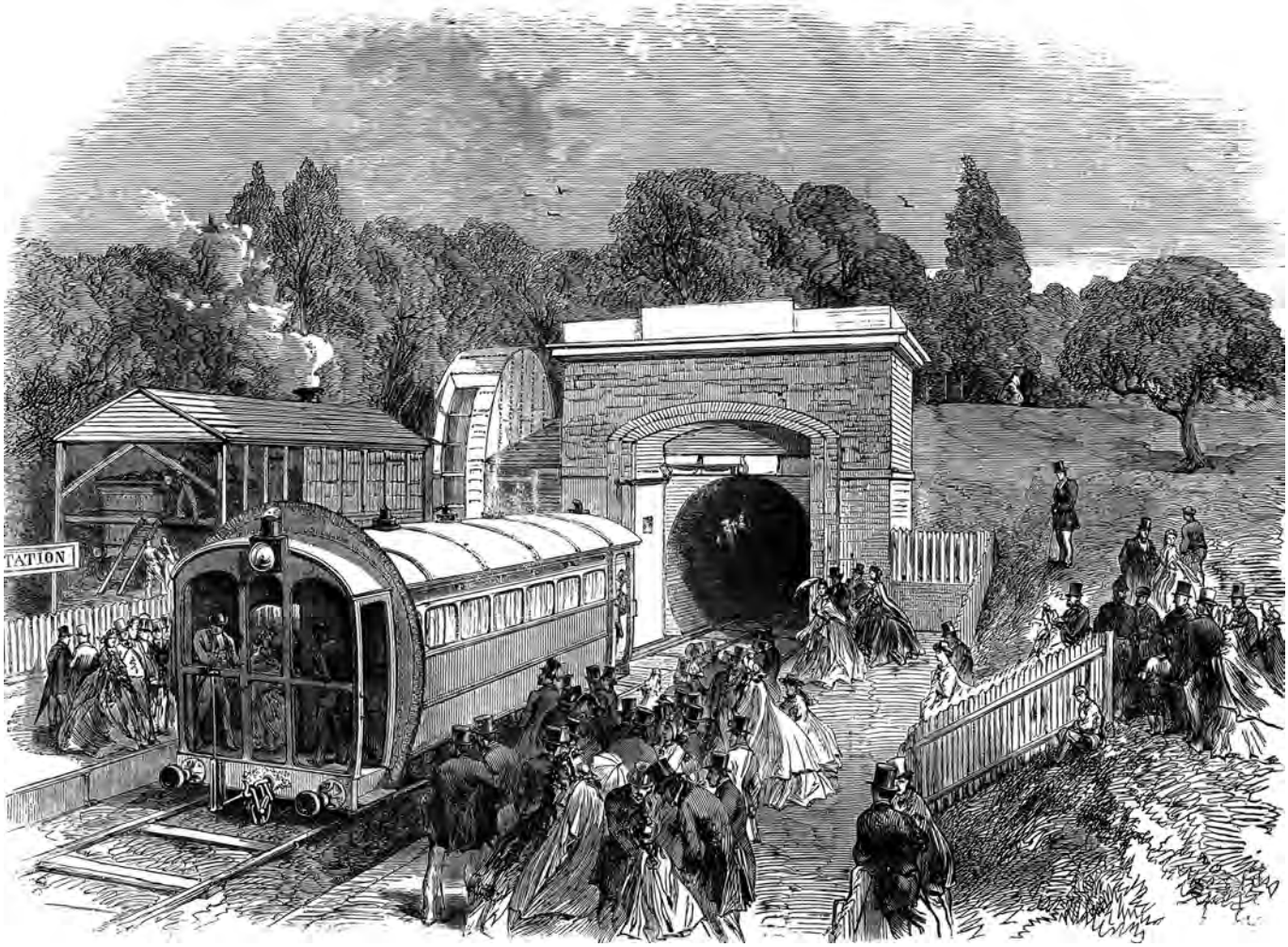
Paul Miller (the current custodian of the control bunker)

Finally, in memory of C/Obs David Hogarth, whose uniform now adorns 'Pete' in the recreated monitoring room.

The surface features in their third reincarnation in Goosnargh, with vents, hatch, GZI, FSM probe head and BPI baffle all in position in 2013. Catforth post never had a radio, so currently this is only a representative item. Photo Mike Norris

Thomas Webster Rammell's 'pneumatic railway' tunnel Crystal Palace Park, South London

Paul W. Sowan



Departure from the upper station. This illustration seems likely to have been sketched on site. Passengers are seen boarding the carriage while spectators watch from the opposite platform. An open timber pump house and fan casing are shown in some detail. The pumps were steam powered and a tender locomotive is seen inside the building. Beyond the portal, the brick tube is clearly an earthed-over surface structure and the apparent hill is artistic licence as there is no hill near the Sydenham entrance. The track bed is clearly in a shallow cutting. From Illustrated London News *10 September 1864*

A passenger-carrying railway carriage propelled, effectively, as a piston blown along in a tube by air pressure was demonstrated in a 600-yard brick tunnel in Crystal Palace Park, Sydenham, in 1864. The park was laid out as a pleasure ground from 1854 onwards, following the relocation of the Great Exhibition building of 1851 from Hyde Park.

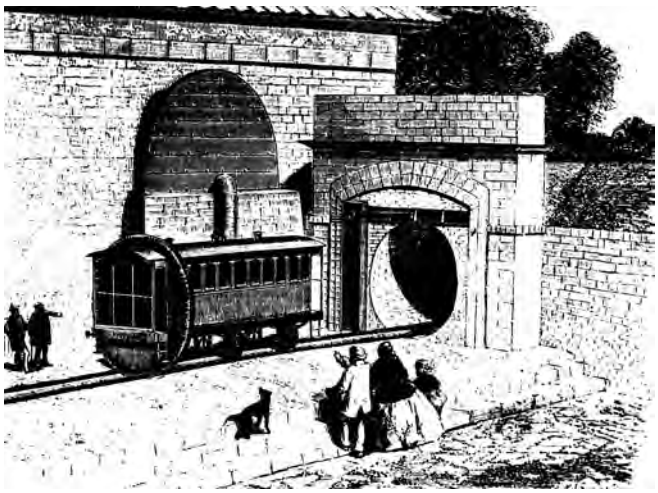
A description and a depiction of one of the portals, and of the carriage and passengers, was published in the November 1864 issue of the *Practical Mechanic's Journal*, and has subsequently been reproduced in a number of books and magazines. The engineer was Thomas Webster Rammell (1814–1889).

This 'tunnel' story has given rise to much speculation about the possibility of there being an abandoned tunnel awaiting discovery under the park. The more imaginative have even concocted stories about such a tunnel still containing the carriage and its passengers!

The reality is that this 'pneumatic railway' was never more than a temporary demonstration, the 'tunnel' being built on the surface of the park between January and August 1864, and all (or almost all) tangible remains of it removed by the end of 1864, the trials having finished on 31 October. The following account draws on the 1864 description and on Sub Brit member Roger Morgan's researches into Thomas Webster Rammell.

The 1864 demonstration

> The Crystal Palace grounds were, during August last, the scene of a very interesting experiment. A series of trial trips (the first was on 27 August) on the model Pneumatic Railway, recently constructed there, under the superintendence of Mr. Rammell,



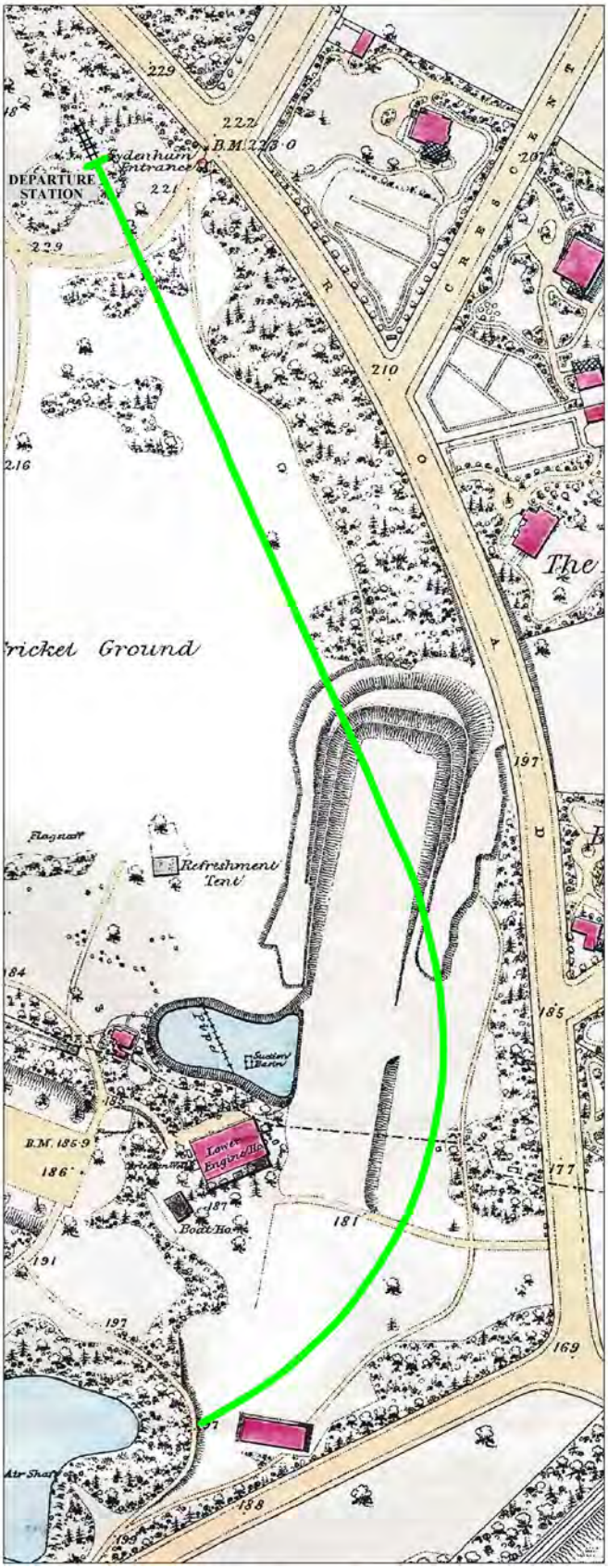
Upper station. It is likely this is an 'artist's impression' or interpretation of a written or spoken description. The massive masonry structure seems unlikely for what was never intended to be more than a temporary demonstration. It appears to be a poor representation of the timber pump house with the fan in the wrong place. It should be alongside the tunnel portal. It is also noteworthy that no platforms are represented: climbing on or off a railway carriage from track bed level calls for some agility!
From Merveilles de la Science *(Paris 1867 & 1870)*

C.E., took place with perfect success, in the presence of several eminent engineers and scientific men. A brickwork tunnel, about 10 ft high by 9 ft wide, and capable of admitting the largest carriages used on the Great Western Railway, has been laid with a single line of rails, fitted with opening and closing valves at either extremity, and supplied with all the other requisite apparatus for propelling passenger trains on the pneumatic principle.

The tunnel, or tube, extends from the Sydenham entrance of the grounds to the Armoury, near the Penge gate, a distance of nearly 600 yards. The object of laying down this experimental line is to afford, both to the scientific world and the travelling public, a practical demonstration of the applicability to passenger traffic of the motive power already employed by the Pneumatic Despatch Company in the conveyance of letters and parcels.

The pneumatic principle of propulsion is very simple. The train is driven along in one direction by a strong blast of air, and drawn back again in the opposite direction by the exhaustion of the air in front of it. The train may be said, in fact, to be blown through the tube on the down journey, and sucked through it on the return journey. It must not, however, be supposed that the passengers are deposited at their destination with a sudden jerk.

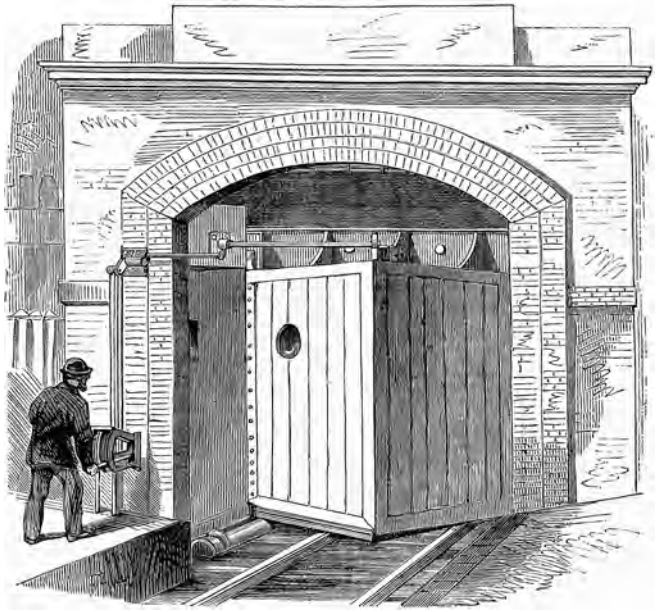
Such an inconvenience is entirely obviated by the mechanical arrangements employed. The motion is throughout smooth, easy, and agreeable, and the stoppages are effected gently and gradually. Indeed, when it is considered that the curve in the tunnel is



1863 1:1.056 OS Town Plan showing the approximate location of the tunnel which ran from the Sydenham gate to the armoury near the Penge gate.

unusually sharp, being of eight chains radius, and that the gradients are as high as 1 in 15 (those of Holborn Hill being only 1 in 18), it is surprising that the motion should be so much steadier and pleasanter than ordinary railway travelling.

The journey of 600 yards was performed either way in about 50 seconds, with an atmospheric pressure of only 2½ ounces to the square inch; but a higher rate of speed, if desirable, can easily be obtained consistently with safety. Indeed, one great incidental advantage of this species of locomotion is that it excludes all risks of the collisions occasionally attendant on railway travelling; for it is plain that no two trains could ever run against each other where all the propelling force is expended in one direction at one time.



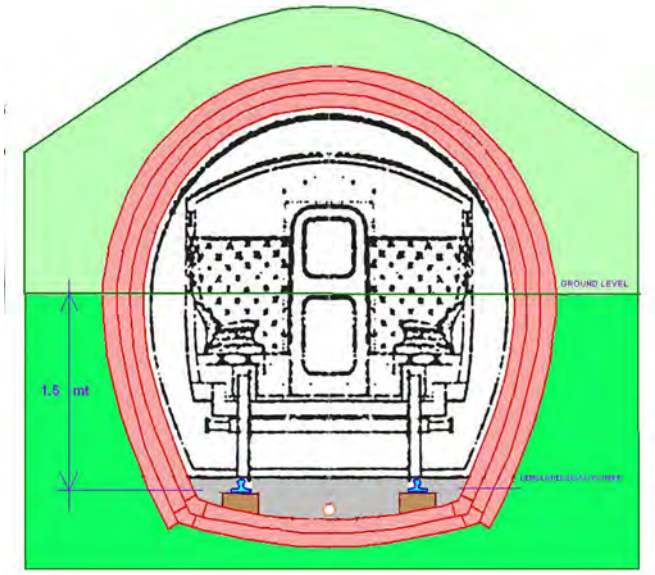
Upper station doors, hung like lock gates.
The original caption on this engraving said
'The pneumatic railway at Crystal Palace: starting the train'.
From Illustrated Times, *10.9.1864*

The worst mishap which it is said could well happen is that, owing to some sudden failure of the machinery, the train might be abruptly brought to a dead stop in the middle of the tunnel, when the passengers would have to alight from the carriages and grope their way as best they could out of the tube. Such a predicament certainly would not be enviable, but it might be more ludicrous than dangerous. Whether in such a contingency there is any possibility of another train being started before they had safely made their exit, or any risk of their sharing the fate of frogs placed under an exhausted air-pump, we do not venture to assert; but probably the scientific engineer could guarantee the traveller against any such novel peril.

The train used consisted of one very long, roomy, and comfortable carriage, resembling an elongated omnibus, and capable of accommodating some 30 or 35 passengers. Passengers enter this carriage at either end, and the entrances are closed with sliding glass doors. Fixed behind the carriage there is a framework of the same form, and nearly the same dimensions, as the sectional area of the tunnel; and attached to the outer edge of this frame is a fringe of bristles forming a thick brush.

As the carriage moves along through the tunnel the brush comes into close contact with the arched brickwork, so as to prevent the escape of air. With this elastic collar round it, the carriage forms a close fitting piston, against which the propulsive force is directed. The motive power is supplied in this way: At the departure station a large fan-wheel, with a iron disc, concave in surface and 22 feet in diameter, is made to revolve by the aid of a stationary steam locomotive at such speed as may be required, the pressure of air increasing, of course, according to the rapidity of the revolutions, and thus generating the force necessary to send the heavy carriage up a steeper incline than is to be found on any existing railway.

The disc gyrates in an iron case resembling that of a huge paddlewheel; and from its broad periphery the particles of air stream off in strong currents. When driving the air into the upper end of the tunnel to propel the down-train, fresh quantities rush to the surface of the disc to supply the partial vacuum thus created; and, on the other hand, when the disc is exhausting the air in the tunnel with the view of drawing back the up-train, the air rushes out like an artificial hurricane from the escape valves of the disc case, making the adjacent trees shake like reeds and almost blowing off his feet any incautious spectator who approaches too near it.



Cross section of carriage inside the brick tube 'tunnel' showing conjectural level of the track in relation to ground level in the park. The track bed is shown as a few feet below ground level, but the upper part above.
Section adapted from the patent drawing by Roger Morgan

When the down journey is to be performed the breaks [sic] are taken off the wheels, and the carriage moves by its own momentum into the mouth of the tube, passing in its course over a deep air-well in the floor, covered with an iron grating. Up this opening a gust of wind is sent by the disc, when a valve, formed by a pair of iron doors, hung like lock-gates, immediately

closes firmly over the entrance of the tunnel, confining the increasing atmospheric pressure between the valve and the rear of the carriage.

The force being thus brought to bear upon the end of the train, the latter, shut up within the tube, glides smoothly along towards its destination, the revolving disc keeping up the motive power until it reaches the steep incline, whence its own momentum again suffices to carry it the rest of the distance. The return journey, as above indicated, is effected by the aid of the exhausting process. At a given signal a valve is opened, and the disc-wheel set to work in withdrawing the air from the tube.

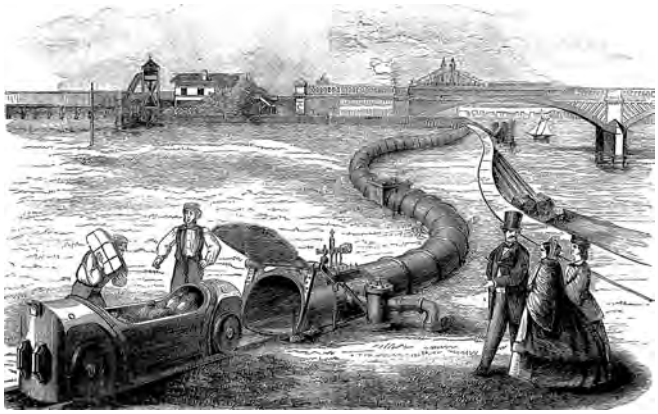
Near the upper end of the tube there is a large aperture, or side-vault, which forms the throat through which the air is, so to speak, exhaled, the iron doors at the upper terminus still being kept shut. In a second or two the train posted at the lower terminus, yielding to the exhausting process going on in its front, and urged by the ordinary pressure of the atmosphere from behind, moves off on its upward journey, and rapidly ascending the incline, approaches the iron gates, which fly open to receive it, and it emerges at once into daylight.

Such is the mode in which the system works, and it seems capable being adapted to railway communication within the metropolis and other large towns, or wherever tunnelled lines with steep gradients exist. The chief obstacles encountered in practically working the atmospheric railway, introduced some 15 years ago, are considered to have been effectually overcome by the present modification of the principle.

Under the former system the tube was of very small size, and fixed upon the ground; a longitudinal or continuous valve opening at the top, along with a rod, connecting the piston with the carriage, passed, and the valve closing behind the rod as it moved onwards. The amount of atmospheric pressure required to be exerted where the area of the tube was so small, was enormous, being from 7 lb to 10 lb per square inch; whereas upon Mr Rammell's principle the pressure is only 2½ oz. per square inch, and, moreover, the great leakage and waste of power which rendered the old atmospheric system so costly in working are here in great measure avoided.

Thomas Webster Rammell

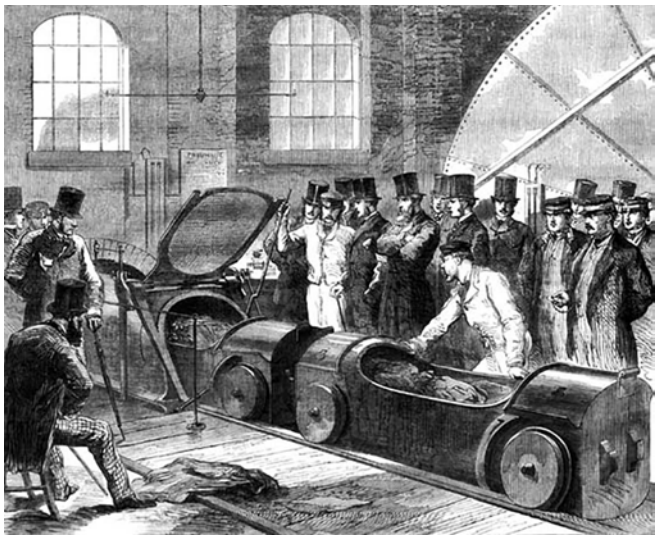
Roger Morgan's research throws more light on this temporary installation, and on the engineer who designed it. Thomas Webster Rammell was a pupil of the railway engineers George and Robert Stephenson, and worked on the Chester & Crewe Railway and on water supply and drainage systems. He was aware of the London & Croydon Railway's 'atmospheric' railway which operated (alongside conventional locomotive-hauled trains on adjoining tracks) for less than two years before being abandoned in the mid-1840s.



The first full-scale trial of Rammell's pneumatic despatch was at Battersea Fields during the summer of 1861. A single tube was installed, 452 yards long, with curves of up to 300 feet radius and gradients of up to 1 in 22.2 ft., narrow gauge track was laid inside the tube. Wheeled capsules were fitted with vulcanised rubber flaps to make an air seal. Power was provided by a 30 horse-power steam engine with a 21 feet diameter fan. Single capsules weighed up to 3 tonnes, and achieved speeds up to 40 mph.
From Illustrated London News *1861*

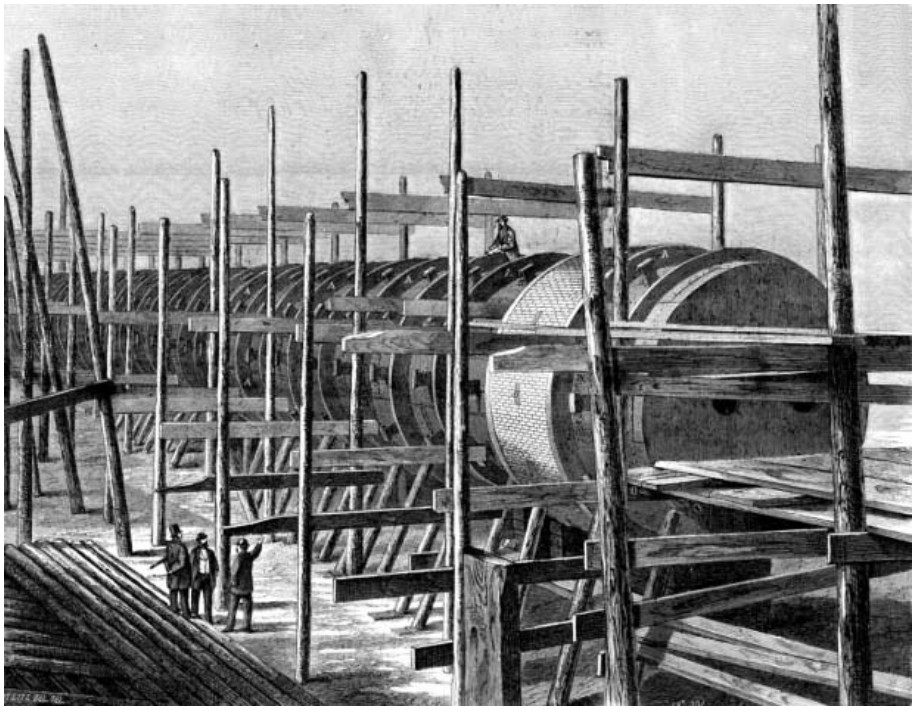
Brunel's 'atmospheric' line for the South Devon Railway was similarly a failure. The motive force for the 'atmospheric' trains was air pressure which pushed a piston (attached to the underside of the carriage) along a 15-inch-diameter cast-iron tube, from which air had been pumped out ahead of the train.

Rammell's invention, which also depended on atmospheric pressure, was to make the entire vehicle the piston, pushed along inside a much larger cast-iron tube (so, as with the early Waterloo & City Railway, there would be no views to be seen from the carriage windows). As the piston had a much greater surface area, a much lower air pressure was needed for propulsion.



First despatch of mail bags through the pneumatic tube from the District Office in Eversholt Street to Euston Station.
From Illustrated London News *18 February 1863*

He took out a number of patents for this idea between 1858 and 1864, and formed the Pneumatic Despatch Company which built a small-scale pneumatic railway to convey mail back and forth between the General Post



Rammell's passenger-carrying line under construction at Waterloo in 1866

Office and Euston Station. This 4.33 km line was laid in an iron tube below the streets, and did actually work from 1872. However, the GPO abandoned it in 1874.

Rammell also commenced construction of a larger, passenger-carrying, line from Waterloo Station under the Thames to Whitehall in 1866, but work was halted the following year on account of the Overend Gurney bank crash. Rammell's finances suffered, and the under-Thames line was never resurrected. His tunnel, had it been completed, would have been the second such after the Brunels' Thames Tunnel.

Rammell lies in an unmarked pauper's grave in a cemetery at Watford. Roger Morgan's assessment is that his lack of success with pneumatic railways was more a case of bad luck than technical failure.

Does anything survive in the park?

The well-known illustration, and the technical description in 1864, suggest that there is no tunnel awaiting discovery below the grass. Over the years there have been numerous rumours of a lost train complete with passengers being sealed up in Rammell's tunnel in Crystal Palace Park. The origin of these rumours is not known but may have been started by local school children in the 1930s. The children's tale says the tunnel was shut down as a commuter train was trapped when the tunnel collapsed. The local tale goes on to say that the tunnel was walled up with the passengers still inside the train.

The search for Rammell's Crystal Palace Pneumatic Railway was well publicised in 1975. The London Underground Railway Society's Peter Davis was extensively interviewed on national and local press and TV, where he explicitly mentioned the hope of finding the train in the tunnel. *The Times* of 21 July 1975 reported:

PLAN TO DIG FOR TRAIN IN 'LOST' TUNNEL

What could have been the earliest underground passenger train in Britain may be unearthed in a lost tunnel at Crystal Palace when railway enthusiasts begin excavating next month . . . . "With any luck we will find the train inside the tunnel"

Roger Morgan took part in the subsequent digs on 3 and 10 August 1975 facilitated by GLC member and Chairman of the London Subterranean Survey Association the late Ellis Hillman. Unfortunately the tunnel wasn't found so the rumours of the lost train continued.

In 1978, 19-year-old Pamela Goodsell claimed she had found the tunnel and within it was an old railway carriage. Her story also included the bizarre details that the occupants were still in the train and were skeletons dressed in Victorian clothes. However she was unable to lead anyone to the hole she claimed to have fallen through and where she claimed the hole had been was close to the site of the palace so it couldn't have been Rammell's tunnel. She subsequently moved to the position of the experience being 'psychic'.

The site of Per Von Sheibner's excavation. He was only allowed to dig one trench in the attempt to locate the tunnel. Luckily, he managed to get hold of an aerial photograph, part of a survey commissioned by Bromley Council that summer. A summer drought had left the grass scorched while the grass above the infilled trench where the tunnel had been was less parched and the resulting 'crop mark' clearly showed the course of the tunnel. Photo Roger Morgan

The truth at last

On 12 August 1989 an exploratory trench in Crystal Palace Park, 45 metres south of the Sydenham entrance excavated by local archaeologist Per Von Scheibner (also known as Marquis de St Empire) finally revealed the remains of the tunnel 1.5 metres below the surface. The brick tunnel had been demolished down to the track

bed, leaving the brick invert supporting longitudinal pine sleepers spaced at standard gauge (4' 8½"), with a central drainage pipe, and backfilled with crushed bricks and a layer of cement. As the tunnel is shown as 3.65 metres high on the patent drawings this resolves the question of how deeply it was buried - it was cut and cover, with half below and half above ground. No doubt the spoil from the trench was piled on top to disguise it somewhat, as can be seen in the elevation of the portal in the patent. Thus the apparent below ground tunnel of the *Illustrated London News* engraving (reproduced on page 53) is a carefully contrived sham.

The two longitudinal sleepers with the drain pipe between them are clearly visible in the trench. As the sleepers were 4' 8½" apart (standard gauge) this confirms, beyond reasonable doubt, that Rammell's tunnel had been found

1864 trip report

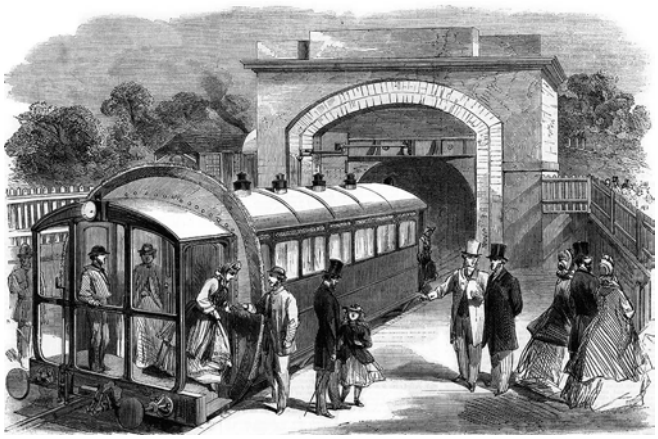
All the illustrations of the carriage apparently show it at the upper station, the carriage evidently having the air-tight seal at its uphill end, and no mention of any means of turning such as a turntable. The text refers to the starting and arrival of the carriage at the 'respective ends of the tube' but it appears that the lower end of the tube is never depicted. Passengers had a return trip, presumably not alighting at the lower end, so all departures and arrivals were at the upper station. The cost of the return journey was 6d.

The down journey evidently commenced with the carriage being pushed into the tube beyond the air tight doors. When the doors were closed behind it, air was pumped in behind the carriage, its over-pressure pushing it downhill. To what extent it would in any event have simply rolled downhill is not clear. How and where (still inside the tube, partly outside apart from the air-tight seal, or fully out into the open) the carriage was halted at the lower end is not clear. Was there a 'station' with a platform at all at the lower end? Or buffer stops? Or even a portal?

The carriage was reportedly pushed back uphill by the external air pressure exceeding the reduced pressure inside the tube, air being pumped out ahead of the carriage. It could only have worked if the carriage seal end, at least, was already inside the tube. Had the carriage exited completely, it would have had to be pushed manually back in.

A contemporary report in the *Bedfordshire Mercury* on 3 September 1864 that describes in detail a journey on Rammell's pneumatic railway shortly after it opened is reproduced below. The writer describes a journey from the lower station. This is the first written evidence that there was, or may have been a station by the Armoury.

> Visitors to the Crystal Palace who enter by Sydenham or Penge must have observed that certain works have been for some time in progress at the lower part of the grounds between the two entrances alluded to. These works are now completed and consist of a railway of about 600 yards in length, laid in a tunnel arched with brick and covered with clay to a depth of about eighteen inches. The railway passes over an incline somewhat more step than Holborn-hill for some distance, then over one of a less gradient, and finally along a level to the upper station. At about 50 yards from the mouth of the tunnel, which is provided with folding doors, is an opening on the left hand side leading to the centre of a gigantic fan, twenty-two feet in diameter, which is worked by a steam engine, and which is also connected with other underground passages, one top assist with the carrying off of the air drawn from the tunnel, and another to admit air to the fan when it might be requisite to blow into the tunnel. Doors or valves in these passages are worked from above by means of leavers, so as to shut off one or the other as may be needed.
>
> The carriage is built in one compartment with a platform at each end, on which the guard stands to manage the break, and is fitted up as a first class carriage, with seats along each side like an omnibus, the passengers entering by doors in the centre of the platform. At one end is a flange or wing extending round it, made in the shape of the tunnel, and edged with bristles so as to form a continuous brush and to allow of the escape of as little air as possible. The carriage starts down an incline to the mouth of the tunnel, which it enters with the impetus, and on passing the draught-pipe (the door behind being shut



Passengers are seen disembarking from the carriage after arrival at the upper station at the end of the return journey. Compared to the ILN engraving the pump house is set a little further back and the land to the rear of the portal is not so hilly which is a more accurate representation of the land around the Sydenham entrance.

to prevent the escape of air) the fan draws air from the supply pipe and forces it into the tunnel behind the carriage, which is thus blown through the top of the steep incline, whence it descends with a lesser blast, warning being given by telegraph to the engineer. On the return of the carriage the process is reversed. So soon as it has reached the tunnel down a similar incline to that at the other end, warning is given and the air to the tunnel is admitted to the centre of the fan, which draws it up, driving it out through various channels opened for the purpose; and the air in the tunnel being thus somewhat exhausted, that behind the carriage drives it up the incline, of 1 in 15, mentioned above as steeper than Holborn-hill, and on to the upper station, the doors of the tunnel being opened as soon as it passed the exhaust pipe.

We went to the lower station, and there entered a carriage to be sucked up the tube with several other passengers. We found the motion easy and regular, and were surprised at the inclination of the carriage on the steep part of the steep part of the road, which is such as no ordinary railway ever travelled up. There were no inconveniences experienced from the pressure of air, though of course if the two doors of the carriage had been opened we must have felt the effects of the draught: this of course would seriously impede, if not wholly arrest, the progress of the carriage.

This modification of the pneumatic railway is the contrivance of T.W. Rammell Esq., who opened the line on Saturday, and must have been highly pleased with the success of the experiment so far. The carriage travelled up and down the line at frequent intervals from two o'clock till dusk, conveying passengers back and forward, all of whom were pleased to enjoy the novelty of this mode of progression.

SOURCES:

RAMMELL, Thomas Webster, 1864, The pneumatic railway at Sydenham. *The Practical Mechanic's Journal* 17(200) (1 November 1864).

MORGAN, Roger J., 2008, Entry for Thomas Webster Rammell: M.M. Chrimes *et al., Biographical dictionary of civil engineers in Great Britain and Ireland. Vol. 2: 1830 – 1890.* London: Thomas Telford Ltd (pages 638–639).

Morgan, Roger J – Letter to the *Fortean Times*

Bedfordshire Mercury 3 September 1864

World War I explosives storage in the 'caves' at Reigate, Surrey

In 1921 very large parts of central Reigate were sold by the town's then major landowner. A substantial sale catalogue, with 122 pages and four large folded coloured plans, was issued. This contains detailed descriptions of each individual property offered for sale, including premises (mostly shops), especially in Reigate High Street, with 'caves' behind or below them. The exact extent of many of these 'caves' or rock-cut cellars was stated to be unknown, as at least some of them are reported to have been 'blocked up by the Military Authorities during the war'. This was the case, for example, at 'The Market Stores' licensed hotel at 2 High Street, where 'a sand cave extends under a portion of these premises'.

Some light is thrown on why the military authorities blocked access to the 'caves' in a letter preserved in the archives of the Holmesdale Natural History Club, a body established in the town in 1857 and which today includes archaeology and local history in its area of interest. The letter, written by a Mr. Makovski (of Tamplin & Makovski, electrical contractors of Reigate) is dated 9 June 1933 and was addressed to one Spranger, who is not otherwise identified. One Lt. Col. Francis Jefferis Spranger, however, was listed in Kelly's 1930 Surrey directory as living at Castle Keep, a large house standing in the Castle Grounds but not quite directly above the Tunnel Road West 'caves'.

Alongside a humorous account of how the War Office operated in or about 1917, the letter confirms that the 'caves' on the west side of Tunnel Road were indeed used for World War I military storage purposes (probably explosives rather than filled bombs); that the mined tunnel linking the 'main' cave to the Constitutional Club cave and the Market caves to the south was created by the War Office; and that the plan of all the west side 'caves' was drawn by Makovski, this being (with modifications) the one used by Reigate Borough Council in connection with its deep air-raid shelter project in World War II.

Details of all but two of the other premises along the north side of Reigate High Street (all offered for sale) reveal that those with 'caves' closest to the east end (and so closest to the War Department's store) were also subject to the blocking-up requirement. Presumably the military authorities were quite reasonably anxious to prevent general access to the explosives via uncharted or newly dug connections.

SOURCES: KNIGHT, FRANK, & RUTLEY, 1921, *Particulars, plans and conditions of sale of the greater part of the Town of Reigate … the freehold estate .. to be sold … on Wednesday, Thursday and Friday, the 26th, 27th and 28th October 1921*. Knight, Frank & Rutley [auctioneers]: 122pp + four coloured folded plans; WINDER, Paul, 2015, Tunnel Road West Cave as a World War I bomb store – the inspector visits. *Bulletin Holmesdale Natural History Club* 111, 5 – 8.

Veni Vidi Descendi – Sub Brit visit to Rome

Nigel Headley

The density of burials in the Priscilla Catacombs in central Rome on Via Salaria is evident in this view

Rome is a great city. It's arguably the greatest city in the world, at least in a historical sense. The earliest foundations were laid over 2,500 years ago and its history presents layer upon layer to the present day. This is no grassy mound on a remote plain surrounded by seven hills; it is the data bank of the modern world with a direct line to the most ancient Europeans.

Layers of history

It has been said many times that there is more beneath the ground in Rome than there is above and the nature of the soil means that revealing the past by digging is a very rewarding process. The Tiber flowing through Rome floods regularly and this, coupled with using older structures as foundations for more modern buildings, has led historically to the burial of the ruins and the construction of each next phase above more ancient layers. On top of this (figuratively, not literally) there are many purpose-built underground structures, whose functions include storage, transport, religion and shelter.

Subterranea Britannica has always enjoyed excellent links with our continental cousins and Linda and Martin Dixon attended an international conference in Rome in March 2015. The links made at this formed the foundation of the arrangements for the Sub Brit weekend in May 2016. Martin and Linda, with help from Tony Radstone, put together a splendid visit – giving us privileged access to sites normally closed to the general public. Martin also put together a pack of site notes, some of which have been gratefully incorporated within this article.

The weekend comprised a series of visits ranging from ancient sites to twentieth-century bunkers so there was something for everyone's tastes. It was good to see some familiar faces amongst the attendees but for around a quarter it was their first Sub Brit weekend. The official gathering began on Friday although the huge scope of sites in Rome meant that many members opted to arrive early and/or leave late to add a public site or two to their itinerary. A couple of examples of such subterranean sites are included at the end of this article, but to continue....

Stewart Wild, John Burgess and I arrived on the Thursday night (May 5), staying near the airport on the coast to the west of Rome and shared a taxi into the city on the

Friday morning. Highly recommended, as not only was it cheaper than the train but the driver gave us a guided tour of above-ground Rome in transit to the hotel, the *Mercure* on the northeast side of Rome near Bologna metro station. That's a lot of free info!

The Church of San Clemente and its Mithraeum

On Friday, having free time before the start of the weekend, we made our way – as did numbers of other Sub Brit members in their free time – to the church of San Clemente, a 17th-century building a few hundred yards from the Colosseum. It was given to Irish Dominican monks in perpetuity after the dissolution of the monasteries in England. In 1857 the prior Father Joseph Mullooly excavated underneath the present church and uncovered a fourth-century basilica and on a second level beneath that a first-century mithraeum with all the traditional characteristics.

Stairway in the Church of San Clemente, showing the lighting which cleverly imitates Roman torches

This lower level also contains some rooms from a Roman townhouse and the foundations of what might have been Rome's Mint. All of these works are impressive and the site is well worth a visit. A twentieth-century footnote was that the original diggings soon became flooded by a spring and in 1912 the then Prior courageously excavated a tunnel running 700 yards to the Cloaca Maxima, Rome's ancient sewer, at the Colosseum and at a depth of 40 feet under the roads to drain away this water. That spring still flows today.

The first underground level beneath the Church of San Clemente, showing the fine vaulting and remains of wall paintings around the outside walls

San Clemente lower level; the left-hand wall showing a distinctive pattern of square bricks (opus reticulatum). This area adjoins a so-called Mithraic School

Royal shelter

The first official visit was to the Italian Royal Family's air-raid shelter dating from World War II. Most of the early arrivals were able to attend but numbers were limited. Sadly Stewart, John and I were too late in booking so this site is described by Martin:

In the UK it is not well known that Italy's Royal Family ruled throughout World War II alongside Mussolini's Fascist party and was only deposed when the Italian Republic was established in 1946. Their seat for the final period of their reign was Villa Ada Savoia which was also the location of Mussolini's arrest on 25 July 1943. On the establishment of the Republic, King Victor Emmanuel III fled to Egypt and his son to Portugal. As a result of the generosity of Egypt, the Villa was given by the King to them and is now the Egyptian Embassy.

We were met at a convenient bar/cafe by Adriano Morabito, President of Roma Sotterranea, who along with his colleague Marta was a great help in arranging our weekend. We strolled into the Villa Ada park – now Rome's second largest park – where there are a number of underground structures. These include an old tuff quarry, the Priscilla Catacombs and the course of the Aqua Virgo aqueduct which originally supplied the famous Trevi Fountain. We would be visiting examples of these site

types later in the weekend but were here to see a later structure. Initially the existing cellars of the Villa were used for air-raid protection but around 1941 a purpose-built bunker was built for the rulers.

Surface briefing outside the Villa Ada shelter. The site was chosen for the small wooded hill above which gave both mechanical and visual protection

The shelter is about 350 metres from the Villa, taking advantage of the cover of a small hill. The Royal Family would not have risked walking this distance during an air raid but would have been driven. Having met our guide Adriano we were firmly on Shanks's pony however. We entered the shelter through blast and gas-tight doors large enough to drive a car into.

Little is visible on the surface although above the site could be seen a series of raised concrete slabs which would have acted as a 'bomb-bursting' layer. These were built around a number of trees to avoid exposing the site to aerial view. Out of sight there is also a small circular building which acted as an air vent and also housed a spiral emergency exit. The more agile of us scaled the steep slope for a closer look.

The distinctive emergency exit atop the Villa Ada shelter

Turning point

Inside, the structure is roughly circular, with a radial extension extending outside the circle where the Royal limousine would have been turned round. One indication that this was no ordinary shelter is that some of the concrete was covered with a false travertine trim. For a number of years the bunker was used by the homeless and also allegedly for satanic rituals. The site was secured in 2012 and since 2015 Roma Sotterranea have put in over 3,000 hours in order to painstakingly restore the site in readiness for guided tours. The bunker was finally opened at the end of March 2016 and so we were amongst the first to visit it.

The turning area (on the right) for the Royal car in the Villa Ada shelter. The seating is modern and for visiting groups. The fine brickwork was heavily graffitied and has now been restored

Off the main circular tunnel there are plant rooms and a staff toilet. Some artefacts are original but many have been painstakingly recovered from secondhand shops or from the original suppliers. The lighting is now low-voltage but this has allowed original design switches to be used which in no way would have met current (ouch) mains legislation.

Villa Ada main entrance blast doors. The small door to the left leads to a guard room

Continuing round the circumference is a passage leading to the emergency exit and we then reached the core of the shelter. This was protected behind separate doors and had additional ventilation to provide positive pressure against gas. An ensuite bathroom held the Royal Seat, and the remains of a pedal-powered emergency ventilation system were also in situ.

Ventilation equipment at the Villa Ada shelter. Batteries are now housed out of sight, but the status gauge is visible

The circular passage turned full circle and emerged by the entrance passage (but not in fresh air) through a small guard room. After a short tour we were given free rein to explore and photograph the site; in my mind the best of both worlds. The site opens around one weekend a month but we were the first foreign group to view the shelter and the splendid restoration that has been achieved.

Into the Metro

Our visits on Saturday were undertaken by public transport and on foot. Public transport is well integrated and the Rome Metro is the oldest in Italy, dating from 1955. A rough cross of two main metro lines (A and B) centres on the main railway terminus with line B passing conveniently close to our hotel.

With so much of archaeological interest buried deep below the city, construction of the metro lines proved challenging in the past and some of the stations contain ancient masonry and relics found at the site. As in other ancient cities such as Athens, the tunnels were dug at a depth below the earliest signs of habitation. This meant that in theory the only damage was made at the sites of the stations themselves and at construction or ventilation shafts.

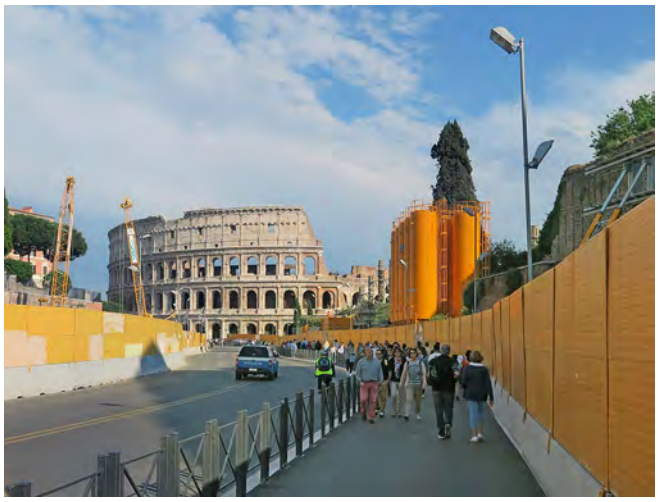
A third line (C) is also under construction but progress is slow due to regular archaeological finds. It has partially opened but it is not yet linked to lines A and B. The simplest ticketing arrangement costs just €1.50 and allows travellers 100 minutes to use bus, metro and tram in any combination. To avoid the delay of 45 Sub Brit members queueing to get tickets, these had been thoughtfully pre-purchased. A couple of armed soldiers provided a reassuring presence at almost every station.

Metro Line B. The condition of the stock is reminiscent of New York in the 1980s

Technically, the metro system operates on standard-gauge track with overhead power supply. Most of the rolling stock on Line B dates from 1990 and most is heavily graffitied, reminiscent of New York in the 1980s. Line A has more modern, air-conditioned coaches and Line C operates with modern driverless trains, constructed by Italian company AnsaldoBreda (now owned by Hitachi). The whole network is operated by Rome's local transport provider ATAC (*Agenzia del Trasporto Autoferrotranviario del Comune di Roma*).

A walking tour of Ancient Rome

Our initial destination was Circus Maximus station and we took the northern exit. We emerged high above the once-tiered banks looking across to the heights of the Palatine hill and its grand Basilica of the palaces that towered over the great race track; a moment of pure Ben Hur!



The Colosseum - newly restored thanks to large donations from private corporate funds. This includes the underground areas beneath the arena. The surrounding area is heavily boarded with much restorative building work in progress. To the right are large cement production units

Sub Brit weekends have a reputation for coinciding with marathons (Gothenburg, Prague, Liverpool ...) and we were amazed to find that the whole area had been cordoned off from the normal frantic traffic for a long-distance walking event. There was something of the ancient games about the day adding to the classical buzz; it also meant that we could enjoy the area in relative peace.

Our day was to take us on a roughly circular tour through the ancient City centre and centred on the Colosseum district. Quite a lot of walking – as we had been warned – but round every corner Rome holds something of interest. The weather was perfect. After walking along the south side of the Circus Maximus we found ourselves at the *Bocca della Verità*, literally the 'Mouth of Truth'.

This is a first-century BC sculpture, a marble face or mask nearly two metres wide, possibly originally part of a fountain or even a well-cover. Legend has it that if you tell a lie with your hand in the mouth then it will be bitten off! Film addicts may remember it featuring in the 1953 film *Roman Holiday* starring Audrey Hepburn and Gregory Peck.

Mysterious Mithraism

After a short delay, we went behind an unprepossessing 1930s office building adjacent to the Circus, and in the shadow of Rome's vast opera scenery-storage building, we were given special access to descend fourteen metres into the basement and beneath to subterranean classical remains. The visit had been arranged by special permission of the Department of Cultural Heritage of the Municipality of Rome, who administer the ancient site.

Mithraeum discovered during the 1930s while building adjacent to Circus Maximus. Ground level clearly seen. These rooms were in the basement of a large Roman house. The gathering room stretches to the right beneath the arches

The high concrete ceiling with modern supports created an underground hall which contains the lower walls of a large second-century Roman house. Some of the rooms had been converted into a Mithraeum later. The floors are uneven and formed of a crazy-paving mix of plundered marble and broken tiles, the central room having characteristic stone benches and a niche where men – never women – congregated. Mithraism was a secret cult or religion centred on worship of the god Mithras. Popular amongst the military, Mithraism was particularly strong in Rome and a number of the temples where followers met still survive.

A fine rectangular carved marble block decorated with a classic motif of Mithras killing a bull sits impressively opposite the stone benches. This carved image is a feature of all Mitraeums (Mithraea?) and this rendition is especially fine. As well as Mithras and the bull, the carving is full of symbolism, including the sun and the moon, a dog, snake, raven, lion and an ear of wheat. In what looks a painful attack, a scorpion is attached to the Bull's testicles.

The sanctum where members had been standing shows a floor made with masonry, marble and tiles in a jumbled surface of make do and old bits. Unusual in the grander context of Rome and its glorious marble clad buildings

The fine bas relief of Mithras slaying the bull. Remarkably intact it is surrounded by platforms and seats. Mithraism seemed to involve men sitting and reclining as part of the ceremony

Appropriately for Sub Brit's interests, the cult met in caves and underground spaces echoing their beliefs and its secrecy. The religion was the mysterious amalgam of the classical gods strangely echoing the looming challenge of Christianity and its one God. Many of its rituals had similarities to the freemasons of today although it has been said that its origins lay in the ancient Zoroastrian faith (yes, Freddy Mercury!).

Roman legions took the faith to the far corners of the Empire, in Britain as far as Hadrian's Wall where a small Temple of Mithras was discovered in 1949.

Members standing on the Roman basement floor being inducted into the mysteries of the ancient religion. The guide has her back to the inner sanctum

Another Temple of Mithras was excavated in the City of London (Walbrook) in the 1950s when its discovery caused a huge stir. (Following recent redevelopment, the mothballed remains are being faithfully reconstructed at the site in Queen Victoria Street and public opening is anticipated early in 2017.)

Members stand in the room where the ancient worshippers gathered. To their left is the impressive white bas relief of Mithras

Claudian tuff quarry

Leaving this mysterious corner we headed across town up the Celian hill to the Piazza Santi Giovanni e Paulo. The imposing building there – a church of the same name – has a convent alongside but a large gateway below, normally closed to those outside the order, reveals the travertine gigantic lower sections of the southeast corner of the vast Temple of Claudius.

This platform originally measured 180x200 metres and was constructed by Claudius' wife Agrippina in 54AD. This, together with huge blocks of travertine that form the base of the bell tower, is all that's left of the first-century temple complex which was larger than the Colosseum when complete. The square outside the gateway looks out upon the church for which the square is named. It's a popular wedding venue, and one couple and their guests were somewhat bemused to find a group of helmeted Brits (mostly) trying to escape the background of their wedding photos!

Members at the bottom of step access being briefed by Adriano Morabito. This was ground level in Ancient times. The brick faced wall was built over the Roman road outside which is now buried six metres below modern ground level

After a short surface briefing, we clambered down some very rusty platforms and ladders, to enter the Claudian tuff quarry. Just yards from an unsuspecting public this site was mined during the Middle Ages. The stone is of volcanic origin and provided a very strong and light building material. It is mainly pyroclastic – mostly ash and cinders and blobs and broken fragments of lava thrown out by volcanic explosions. This is collectively known as tuff.

Rusty staircase from modern ground level to the tuff quarry access

Other materials mined under Rome were *pozzolana* or volcanic sand which was at the heart of all Rome's greatest concrete projects such as the Pantheon – still the largest cast-concrete dome roof ever built (curiously emulated by the great dome of the V2 concrete bunker at La Coupole in Northern France – also intact despite prodigious WWII bombing!).

Tuff was used in Rome's old city walls, some still standing near the central station and elsewhere, but it is not high quality and for important buildings limestone and marble had to be brought down from the Carrara quarries in the north of Italy. (Tufa and travertine are the deposits of lime – calcium carbonate – from mineral springs, especially hot springs, and should not be confused with tuff.)

The main passageway of the tuff quarry divides. The original galleries were much higher and the current ground level includes waste rock and centuries of dumped material

Members in one of the main passageways of the tuff quarry

The Galleries snake out beneath the former Temple area and the porous nature of the soil above makes this is a very wet site. Large lakes collect at the end of these galleries; bringing up the rear of the group I had not heeded the warning from our guide and only narrowly avoided tipping head first into the blackest pool I've ever seen. These formed a great cistern in antiquity and may well have supplied the water that flooded the Colosseum for the naval battles. At intervals there are well shafts bored right through the quarry to the aquifers. Pre-dating the quarry, these supply the convent right up to the present day.

Stacked waste stone and sand within the tuff quarry. It is difficult to comprehend that this is just yards from the crowds of tourists around the Colosseum

After an orientation tour, we were free to wander the site. The more observant could see some electrical fixings

Arched corridor with heaped sand in the tuff quarry

dating from World War II when part of the quarry was used as an air-raid shelter, although it seems surprising that more effort wasn't made to level the floor.

Baths of Caracalla

A welcome lunch break in the hot Italian sunshine allowed members to make their own arrangements before the final visit of the day. Many chose to go alfresco and sample the finest *trattoria*. Reading of the largest underground Mithraeum in Rome recently restored at the spectacular Baths of Caracalla enticed a couple of us to hike to its towering ruins, grabbing less appealing fare. The remains of the baths are some of Rome's grandest; the idea that public baths could match the size and splendour of St Peter's is quite breathtaking.

The signs augured well with descriptions of a network of supply tunnels beneath the complex, and hypocaust heating on an industrial scale. Unfortunately we found the access closed and enquiries at the ticket office were met with blank stares and the fact that it was only open occasionally if indeed ever, despite having received large EU grants to restore it all. Where has the money gone? Very disappointing and very sad.

Indeed, owing to the parlous state of the Italian economy many of the ancient areas are closed "temporarily, due to repairs and renovations", but often with little sign of any work in progress. A new and useful tourist book might surely be the definitive list of sites currently closed, allowing one to concentrate on those actually open!

Domus Romane

The final visit of Saturday was to the *Domus Romane* (Roman house). In full face of Trajan's market place is the Palazzo Valentini, a 16th-century building and the headquarters of Rome's provincial administration. Restoration work in 2005 seven metres below street level revealed the remains of two fourth-century houses, one with a thermal bath. Restoration work has been largely limited to stabilisation but the site now forms the stage for a stupendously impressive visit. The only downside was that photography was prohibited and so readers will have to imagine the splendours.

We entered in small pre-booked groups and moved around a series of darkened well-presented 'rooms' on

reinforced glass floors which allowed us to walk, or rather nervously hover, through the areas as guided by a highly sophisticated system of electronic light and sound effects to bring out the features of the Roman floors and walls below us – perhaps the most impressive use of multimedia yet seen. Even Paul Sowan liked it!

This method of bringing ruins to life must surely be the way forwards. Clever use of light and colour was able to restore friezes, designs, faded walls and floors in an exciting and surprising way.

At one point we walked to the end of a tunnel which had been a World War II air-raid shelter for the city's administrators. This then opened to look out upon onto a normally inaccessible space where Trajan's column stands gloriously with its description of his great victory over the Dacians carved in a spiral frieze.

A presentation on the construction of this immense structure on a screen in a small room at the end of a long hot day looked calculated to produce the usual narcotic effect but only a small minority fell asleep! The capital alone of this immense column weighs 53 tonnes and to raise this in place 34 metres above ground level in 113AD must have been quite an operation.

This marked the end of the day's activities and we headed back to the hotel via the very crowded metro. Security was again highly visible; the soldiers at our local Bologna station were from an Alpine Regiment – with feathers in their hats they looked less than threatening.

A tunnel to eat in

Convivial evening company in the long thin tunnel-like restaurant

Our evening meals were ably supplied by a busy nearby restaurant, *Il Tunnel* (4-stars on *TripAdvisor*). Recommended by our hotel, it was only a couple of hundred yards distant. One felt sorry for the understanding regulars who we squeezed out. Sadly we determined that the restaurant is named as it is long and thin and not for any subterranean connection but the name was more than apt.

The complex dietary needs of a group of our size were smoothly handled by the experienced staff and endless variations of their delicious menu swiftly arrived. Beer or wine was included with the meal and this was supplemented before and afterwards by most of us; both evenings percolated amiably into the night via the hotel bar, jeopardising the strictly enforced early starts of the next day's exploits.

The Appian Way

Sunday involved coach travel and we headed south down the Appian Way. This road was an important route used by the military for supplies and communications. Beginning near the Baths of Caracalla the road passes by the Claudian tuff quarry and for five kilometres carries modern traffic. At which point it separates into the new and old Appian Way, travelling roughly parallel to each other.

Today the Via Appia Antica (old) is a quiet and historic road lined with ancient tombs and memorials put there by rich Romans unable to bury their dead within the city walls. The road surface is still formed in parts by the *pavimentum* of large hexagonal blocks placed in antiquity.

One of its more notorious moments was when Spartacus and 6,000 survivors of his slaves' revolt were crucified along the 200 km road route from Rome to Capua. It was renovated by Pope Pius VI following the collapse of the Western Roman Empire and in 1960 formed part of the marathon course of the XVII Olympiad. It is still has the longest section of straight road in Europe at 62 kms.

San Senatore catacombs

Roman convention was that the dead were buried outside the city walls, with the most wealthy having opulent tombs near to the major city gates. Due to lack of space, existing quarries (originally dug for construction material) were reused as burial chambers. These became Rome's catacombs and were often sanctified with places of Christian worship built over them in later centuries. Earlier theories that the catacombs were places of secret

Descent into the San Senatore Catacomb entrance below the convent of St Mary of the Star on the Appian Way

worship away from oppressive rulers are now largely felt to be overstated.

San Senatore Catacomb was our next destination at the XV milestone (yes folks, and John Cleese, the Romans gave us Miles; until, that is, Napoleon gave us Kilometres!). We were ably conducted through the site by Roberto Libera, Director of the Diocesan Museum of Albano. Other catacombs are open to the public but San Senatore was chosen as it is normally inaccessible apart from special group visits. Roberto was generous enough to waive the normal charges which was a much appreciated generous gesture.

This upper level of San Senatore was decorated with 5th-century wall paintings and served as a chapel or crypta

This catacomb had begun as a *pozzolana* quarry and held funerals from the 3rd century right up to the 12th century. Graves were cut into the walls (*loculi*) and floors (*formae*), while rich people had private rooms or *cubicula*. All of the catacombs in Rome are now owned by the Vatican and most remains have been removed.

San Senatore Catacombs - cavities or loculi were cut into the rock to bury the dead. The burials were held here from the third to the twelfth centuries AD. The passageways were known as ambulacrae

A number of original tile closures were still in place and in some places the graves had room for two or three bodies stacked one upon another. We were told that it was the practice to leave a small opening so the departed could be fed and given wine but (possibly connected) grave attendants were sometimes dismissed for being 'drunk in charge'!

5th-century frescoes in the chapel of San Senatore Catacombs. Despite some damage to the edges, the subjects remain very fresh and clear. Compared to some of the sites we visited this was relatively dry

Larger chambers were designated as chapels for worship and there were some remarkable wall paintings in these. One of the most striking was decorated in the fifth century with Christ and disciples; an interesting convention was that St Peter was white-haired and avuncular, while St Paul had dark hair and was swarthy. One of the rooms held a large well, its date relative to the rest of the excavation not being entirely clear.

A well sunk in the lower levels of the San Senatore Catacombs. Whether for the refreshment of quarry workers or for grievers is not clear

The lower levels of San Senatore are normally off-limits due to the unsafe nature of the " Deads" underfoot. We were allowed special access. Note Andy Catford's special steel safety sandals

As a bonus and because we were an archaeological group, we were allowed access beyond the burial area to the Roman quarry which remained untouched by burials. Clambering over deads (rocks, not bodies!) we were able to reach a number of working faces where two-thousand-year-old pick marks could be distinguished.

The lower levels of San Senatore are a two-thousand-year old pozzolana quarry. Original working faces and tool marks can be discerned

Lunch overlooking Lake Albano

Leaving the catacombs we backtracked to the small village behind for the trek to our lunch stop. The plan had been to travel by coach but it turned out on the day that only service buses were allowed on the route in question. One or two less mobile members gratefully accepted a lift in the only car. For the rest of us the short distance on the map turned out to be a very lengthy and steep climb up the road to Mount Albano which sorted out the men from the boys; the men bringing up the rear!

But the climb was worth the effort and eventually, passing the remains of a massive amphitheatre, we arrived high on the lip of this ancient volcano. Here was a Capuchin monastery with a large open lawn leading to a modest wall. From here there were wonderful views across a water-filled crater, Lake Albano. To our distant left also on the rim of the crater one could see the town of Castel Gandolfo, where the Pope has his summer residence.

Thoughtfully, God and the monks had seen fit to place a large tree in the middle of this open space with a vast spreading foliage that we welcomed for shade in the hot midday sun. A fine spread of local rustic baguettes brought up the mountain by locals and a glass or three of local wine were enjoyed by all.

Lake Nemi and Diana

Refreshed and relaxed we all made the much easier descent to the village and the waiting coach before taking the short drive to the nearby Mount Nemi, another extinct volcano. This time the coach drove us up and over the top into the crater which also turned out to be a National Park and in much the same condition it had been in when visited by the ancient Romans. The sides were heavily wooded and the floor which was not part of the lake had simple farmland and minimal habitation.

In 338BC a temple dedicated to Diana, Goddess of hunting, and the ruins of which can be found in the northeast part of the crater, was built. The temple was subsequently enlarged in 300BC following the construction of the Queen of Roads, the Appian Way. The Sacred Way of Diana is a turning off this road and still follows the same route curving down towards the lake through deep woodland, in places the *pavimenta* still forming the road surface.

With improved access, celebrities and rulers such as Julius Caesar built themselves villas on the shores of the lake. As with Lake Albano, Lake Nemi is the water-filled caldera of an extinct volcano, evocatively called *Speculum Dianae* – the Mirror of Diana – by Servius, because it reflected the moon. A beautiful and quiet backwater of the Roman countryside, but it did have its moment of fame.

Caligula's boats

Caligula, the notorious first-century emperor, commissioned two giant galleys to be floated on the lake, one containing a temple and the other for hospitality. No expense was spared and one can only guess at what took place afloat and out of sight of the plebs.

After Caligula was deposed, the galleys were sunk and long forgotten. From time to time fisherman would bring up pieces from the wrecks and during the Middle Ages attempts were made to find more. Finally, during the 1930s and with the support of Mussolini, a daring plan to drain the lake was enacted.

Caligula galley cast bronze decoration. The forearms with open hands were used to decorate the shallow caissons of rectangular section on the ends of the beams running parallel to the ship's long axis: there must have been four in all, one pair (left and the right hand) on each side, placed stretching horizontally forwards with the palm at an angle on the thumb turned upwards. The forearms extended to keep danger away and to ward off evil. Photo Nigel Headley

Several giant pumps were linked to the ancient Nemi *emissario* (drain) and over several months managed to drop the level of the lake by some sixty feet. In doing so the great vessels, measuring 240 ft x 79 ft and 230 ft x 66 ft, were revealed where they had sunk. To great acclaim they

were dragged from the mud and placed in some splendour in specially designed lakeside buildings – adapted from aircraft hangars and built around the vessels.

Sadly in the latter part of World War II, allegedly, the retreating Germans set light to the wooden hulls and today there are only fragments of the original vessels. The Germans maintained that the fire was caused by incoming US artillery fire and yet another explanation is that dis-housed locals who were living in the buildings used the galleys for fuel.

The buildings survive and fifth-scale models of the boats give some idea of what has been lost; plans to recreate them have so far failed to materialise, other than a rudder profile. Some of the most exquisite items that did survive can be seen in the National Museum in Rome near the central railway terminus. I was lucky enough to find them all on display in a small upstairs gallery. There are some of the huge brass castings at the ends of cross beams with rigging rings.

The Nemi *emissario* (drain)

The reason that Sub Brit visited Lake Nemi was to examine the mile-long drainage tunnel dug in antiquity to lower and control the lake. Some authorities have suggested that it was to prevent the sanctuary of Diana from flooding. Both the volcanic lakes had overflow tunnels cut and the water was certainly used to help irrigation and water supply (and probably to power watermills) in the surrounding countryside and even in Rome.

Entrance to Nemi drain tunnel. Cut stone blocks form a small high roofed entrance passage protruding from the hillside

The tunnel was cut by two teams approaching from either side of the flank of the dead volcano. They used a technique known as cultellation; this involved placing measured poles fixed distances apart and aligning them accurately from portal to portal up and over the top. Collimated light at each end created a spot which was centred dead ahead and the two teams met in the middle.

First entrance chamber of the Nemi drain, formed of cut tuff blocks. Today partially collapsed. Ahead is the upper surviving section of one of two stone debris barriers to stop branches and similar entering; circular holes allowed the flow of water. Maintenance and clearance of the chamber was via access shafts

Slight undulations in the tunnel helped this technique which was an early precursor to modern laser surveying.

The tunnel has a significant kink in level and direction at the joining point between the two drives. This meeting point is much nearer the far portal as the rock on this side is much more dense and hard to dig so that progress would have been correspondingly slower.

A half-hour lakeside walk from the galley museum took us to the opening in the hillside now several metres above the water level, a small stone building protruding from the hillside inside a canopy of an ancient glade of gnarled trees; surely a set from Lord of the Rings?

There are two openings to the tunnel; some twelve metres higher is an earlier portal, presumably relating to a time when water levels were raised. Standing at the mouth of this entrance with the tunnel disappearing steeply downwards, and looking back at the volcanic crater walls opposite, it felt truly Jules Verne!

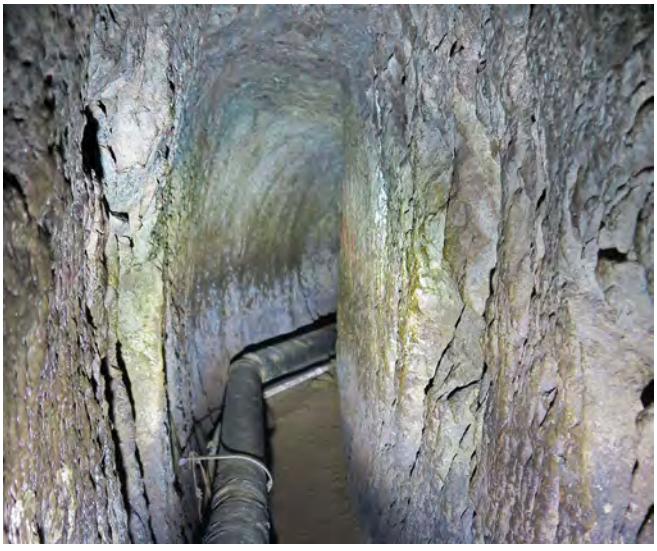
Into the underworld

The lower side entrance was constructed from blocks externally protruding from the escarpment with a now partly collapsed vaulted ceiling and grooved side walls to lower sluices from above. Two stone blocks with holes penetrating acted as a barrier to large debris such as trees. The tunnel is an impressive 5425 ft long and dates from the fourth century BC.

Roughly half and two-thirds of the way through there are diversions to avoid collapses or difficult geology, the rock being uneven tuff. The initial (lower) entry tunnel soon

Beyond the debris barrier of the Nemi drain. The underground junction between the Roman entrance chambers and the mountainside

drops in height and becomes very claustrophobic but it rejoins the main tunnel which is much higher and is quite comfortable if not rather uneven underfoot.



Correctional shifts in the drain occasionally turned a corner

Most of the time there is adequate headroom and width, but crouching and squeezing through gaps is occasionally necessary; there seemed to be fresh air throughout. Cave pearls or speleothems are found in places. Water runs through the drain making Wellington boots a must. I gather Sue Monsell sourced a nice line in fold-up boots from a Glastonbury festival supplier; key issues for cabin luggage and cheap air travel!

Before opening onto a lush hillside, the tunnel eventually becomes very low and adding to the dramatic effect some

In places the amount of water seeping through created pools a foot deep. Calcification leaving white deposits everywhere and some splendid 'cave pearls'. Rather like walking in chalk soil

of the largest mosquitoes I've ever seen swooped bat-like through the flashlights. The profile of the tunnel changes from section to section and the most recent works dates from the 1930s when Mussolini's men used the tunnel as part of his plan to drain the lake.

Some sections of the drain were straight and dry and high. Note the brick arch installed in the 1930s as part of Mussolini's project to strengthen the ceiling

We had timed our arrival so that everyone had a chance to do the through trip, quite an arduous excursion. Around two-thirds of the party managed this but the passageway was punctuated with bottled-out members waiting for guides returning from the west portal! The opportunity to squeeze through some of the by-pass channels was taken by some.

This extraordinary site was for most the highlight of the weekend and one could only marvel at the technical prowess of ancient peoples who could create such a

Other sections were rocky, wet and very difficult. Sharing the space with a modern pipeline proved awkward

Some of the intrepid crew who made it all the way through. Masters of the crouching stride; squeezed, scratched, gouged, soaked and finally spat out into the sun on the west-facing slopes to Ariccia. And then they had to do it all over again - backwards?!

difficult enterprise. This visit was arranged with the kind assistance of Roma Sotterranea who supplied a number of knowledgeable and cheery guides to help us.

The return journey through the square section of the Nemi drain

Mussolini's Villa and three bunkers

After another pleasant evening repast in and around Il Tunnel, Monday arrived and our final visit. This was to the official wartime residence of Benito Mussolini – Villa Torlonia. A short fifteen-minute walk from the hotel brought us to the Villa's spacious grounds, now publicly-owned parkland. The classical Neo-Palladian villa was built in 1806 for Giovanni Torlonia and lived in by a dynasty of rich bankers. As is the way with money, good taste is often the first casualty; the gardens are filled with fake antiquities.

Mussolini became good friends with the bankers and after visiting the house in 1925 he was installed in 1929 with his wife and five young children where they continued to live until he was deposed. He never owned the building and leased it for a token one lira a year.

In June 1940 Mussolini declared war on France and England. There was no bunker built at that time so the large underground wine cellar was brought into use. This was five metres beneath a large ornamental pond some distance from the house and looked ideal for the purpose. There were two access points, the main entrance being down a gentle incline to the accommodation below. Blast and gas doors were installed along with air supply and plumbing. A pedal-operated generator and pump completed its self-containment.

Entrance to Mussolini's original air-raid shelter – a converted wine cellar beneath an ornamental garden lake. The walk from the main villa was vulnerable to air-aids; the base of the pond being unreinforced

Positive air pressure within helped to keep out any potential gas threat. The second emergency exit was up a staircase which led out through more blast doors. Although the bunker was well hidden, its shortcomings

soon became apparent as to get to it the family had to cross open space, potentially putting them at risk. It was not ideal and could only accommodate four members of the family at any one time. Furthermore there was no concrete roof and a direct hit would have had devastating consequences. It was, therefore, decided to create a shelter within the Villa itself.

Gas-proof blast door in Mussolini's original shelter. Some of the rubber seal was still in situ. Space was very limited and certainly not large enough for many beyond the immediate family

Mussolini's second air-raid shelter beneath the main house. This is the air filtration unit and pump and contains activated charcoal

For this the Villa's basement kitchens were converted. It is still possible to see air-filtration units with their activated charcoal and volcanic dust. This (second-phase) shelter has some interpretation boards including correspondence from Churchill deciding that a precision bombing attempt on Villa Torlonia was not worthwhile as *Il Duce* might not be in residence and the collateral damage could be substantial.

Third bunker used by the Allies

Mussolini decided that even this arrangement was insufficient and that he would need a bunker of even greater strength. So in November 1942 construction began on a new and revolutionary bunker. A vast square hole was dug to create the bunker 6.5 metres underground. Within this space a cruciform tubular structure was built. Four metres of reinforced concrete protected the occupants. Access from the Villa was down a ramp with a right angle to reduce blast and four doors closed off the central cruciform space.

Mussolini's final bunker was built just outside the main villa seen in the background. External access and emergency exit was down this ramp

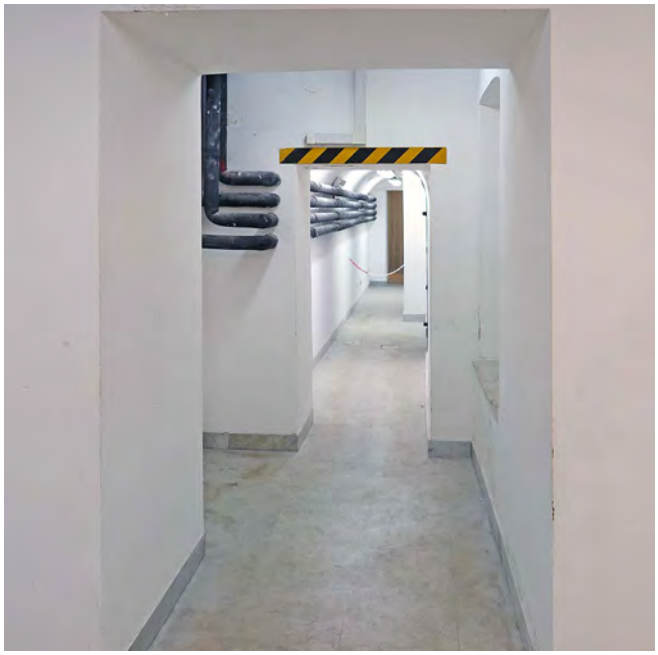
Central space in the cruciform of Mussolini's final unfinished bunker.. Each cross chamber should have had blast doors but these were never installed

The new bunker was linked to the existing cellars by a tunnel. However before its completion, Mussolini was arrested in July 1943 and it was never used by him. The Allied High Command however did use it from June 1944 until 1947. The design of this bunker, revolutionary in its day, pre-empted the Cold War bunkers and their need

Mussolini's final bunker had a cylindrical cross-section for strength. This bay of the cruciform would have contained pumping machinery, never installed. Stewart Wild gazes into what would have been oil storage tanks if they'd ever been fitted

for much greater protection. It could allegedly withstand a 6000 kg bomb's direct hit.

One intriguing additional discovery made during restoration of this final bunker was of some Roman burials beneath the Villa and behind one of the concrete walls. We were guided round these three intriguing shelters by Sotterranei di Roma, another local society which is responsible for giving regular tours round the site. As fellow enthusiasts we were given a special discount and on top of giving an informative tour, Inge and Lorenzo were able to answer our many questions.



Linking corridors joining the Mussolini's second shelter II in the basement to the new external bunker III

"Etruscan" tomb

During restoration work in 2004 a tunnel was cleared and found to lead into a circular room underground in the gardens of Villa Torlonia. It appeared to be an Etruscan tomb and was fully decorated with appropriate artwork on the ceilings and walls. Friezes and frescoes of wildlife in the Etruscan style was highly authentic and has generated myths about Masonic activities within. More research indicated that the owners had created this room in the 1840s reflecting archaeological works that they were carrying out at that time.

In fact the tunnel access had become blocked when Mussolini was creating his bunkers. We considered ourselves very lucky to be able to see this as it is not normally open to the public and we were given special permission by the Superintendent of the Capitoline Museum – recognition of Sub Brit's standing across Europe.

Replica Etruscan tomb created in early 20th century and decorated in traditional ancient style. The public are very seldom granted access; we were very honoured

Departure and conclusions

Villa Torlonia's bunkers concluded the official trip. Farewells were made and many headed back to the UK. Others of us took our chances to seek out new underground territories. Not all were successful; the exciting prospect of seeing the recently opened underground section of the Coliseum turned out to be solidly booked for weeks ahead.

The underground Mamertine prison cells where Vercingetorix and Gauls were held turned out to be shut for renovations. The great subterranean Royal suites of the Palatine all shut. And the greatest treasure trove of all, the Domus Aureus, Nero's buried buildings, also closed.

Latest news from financial sources informs us that Italy is struggling with yet more banking crises. The

prospects for Rome's lower levels are not promising. Luckily, the National Museum was open and I was able to find Caligula's naval embellishments whose splendour hinted at the opulence of the Royal Barges they came from.

In terms of sites that we visited that *are* accessible for public visits, Domus Romane offers regular tours in English and both the Royal Family bunker (Roma Sotterranea) and Mussolini's bunker (Sotterranei di Roma) offer tours that need to be pre-booked.

Several other catacombs are open to the public and the Catacombs of Priscilla are particularly recommended as they are in central Rome on Via Salaria. This makes it difficult for the coach parties (that can spoil a visit to the more popular catacombs) to park. These catacombs contain thousands of graves from the 2nd to the 4th century on multiple levels. A number of Popes and Martyrs were buried here and the chapels within still retain exquisite wall paintings.

A shrine within the Priscilla Catacombs. Some of the burial niches retain brick closures

A small chapel within the Priscilla Catacombs

A final public site is the Case Romane del Celio – beneath the Church of St Giovanni and Paolo. Adjacent to the tuff quarry we visited, this is a complex of different buildings that have been excavated below the present-day surface. The site dates from the 3rd century and the extensive remains were rediscovered in 1887 by Padre Germano. Opened to the public in 2012, the site contains some marvellous mosaics, extensive wall paintings, a Roman alleyway and former watercourses. A museum room also holds some of the more important finds.

The earliest buildings on the site were *insulae* (apartments) and street-front shops. These were separated by a small road or alley from a wealthier *domus* (private house). The *domus* was later converted into an early Christian church. In a final phase of remodelling, the whole complex appears to have been combined into one single grand residence from which period most of the wall paintings date.

Plaque in Case Romane, dating from the final stage of the site, when it became an early Christian Church

Very much the 'low tech' relative of the Domus Romane, the site is equally intriguing and has some of the same feel as the buried city of Pompeii near Naples. The friendly custodian goes out of her way to explain what you are seeing and historian Mary Beard describes it as her favourite site in all Rome. To stand and realise you are viewing a two-storey frontage or an alley dating back two millennia is an enthralling experience.

It's an irony of archaeological history but it's probably worth pointing out that, for all his faults, Mussolini was responsible for bringing to light many of Rome's greatest treasures, his ruthless dictatorship channelling his ambition to see Rome's grandeur return. He made large clearances of existing buildings and slums to expose the ancient relics beneath. Other more questionable changes such as his Via Imperiale that slices across the various

A possible wine cellar in the Case Romane. The original brickwork dates from the 3rd Century but later changes can be seen as the property eventually became one single dwelling

Forum ruins might temper any enthusiasm though.

Anyone wishing to get a feel for the Rome we visited could take a look at the city on any of the Apple gadgets' remarkable map facility in 3D mode (click on the "i" icon). It's a quite stunning facility that allows you to look at the whole ancient city centre in unprecedented detail.

The weekend did leave me pondering the enduring mystery of why in England underground explorers usually look as if they've been dragged through a hedge backwards whereas in Rome our guides were elegantly dressed and coiffured as if they'd just popped off the catwalk. Delightful.

Thanks and appreciation

Linda, Martin and Tony did a splendid job in arranging a packed weekend of such contrasts. It must be a temptation to limit groups to a dozen or so but by careful planning forty-five Sub Brit members were able to sample the delights of Rome, above and below ground.

Thanks must also be given to Adriano Morabito and all at Roma Sotterranea for their help with the planning of the weekend and guiding at some of the sites. And to the Citta Metropolitana di Roma Capitale, Sotterranei di Roma, the Capitoline Museum, the Museo Diocesano di Albano and Musei in Comune Roma for permitting and arranging access to other sites.

As my long-suffering wife Jo has just said: 'Rome wasn't built in a day, and neither was this article'!

All photos by Clive Penfold unless stated.

Meet the Committee – Alistair Graham Kerr

With family roots in both archaeology and the military, I have spent many years researching aspects of fortifications especially those of the twentieth century. My parents were both geologists and then amateur archaeologists, but at the age of twelve I wanted to study a more modern age. So starting with pillboxes along the River Thames, I began looking into military archaeology or, as it is now known, Conflict Archaeology.

I have researched different aspects of defence around the country for the past forty years or more, and I am involved in several projects, one of which is the old Chapel Bay Fort and Museum in Pembrokeshire, which opened to the public in April 2015. I am also Editor of the Pillbox Study Group's journal *Loopholes*.

I have been a member of SubBrit for many years, having known Nick from my early days in the Fortress Study Group. My interest here is Cold War and Second World War although I am not into tunnels a great deal. I did however spend some time exploring the 32km of German underground defences along the Oder Line in Poland.

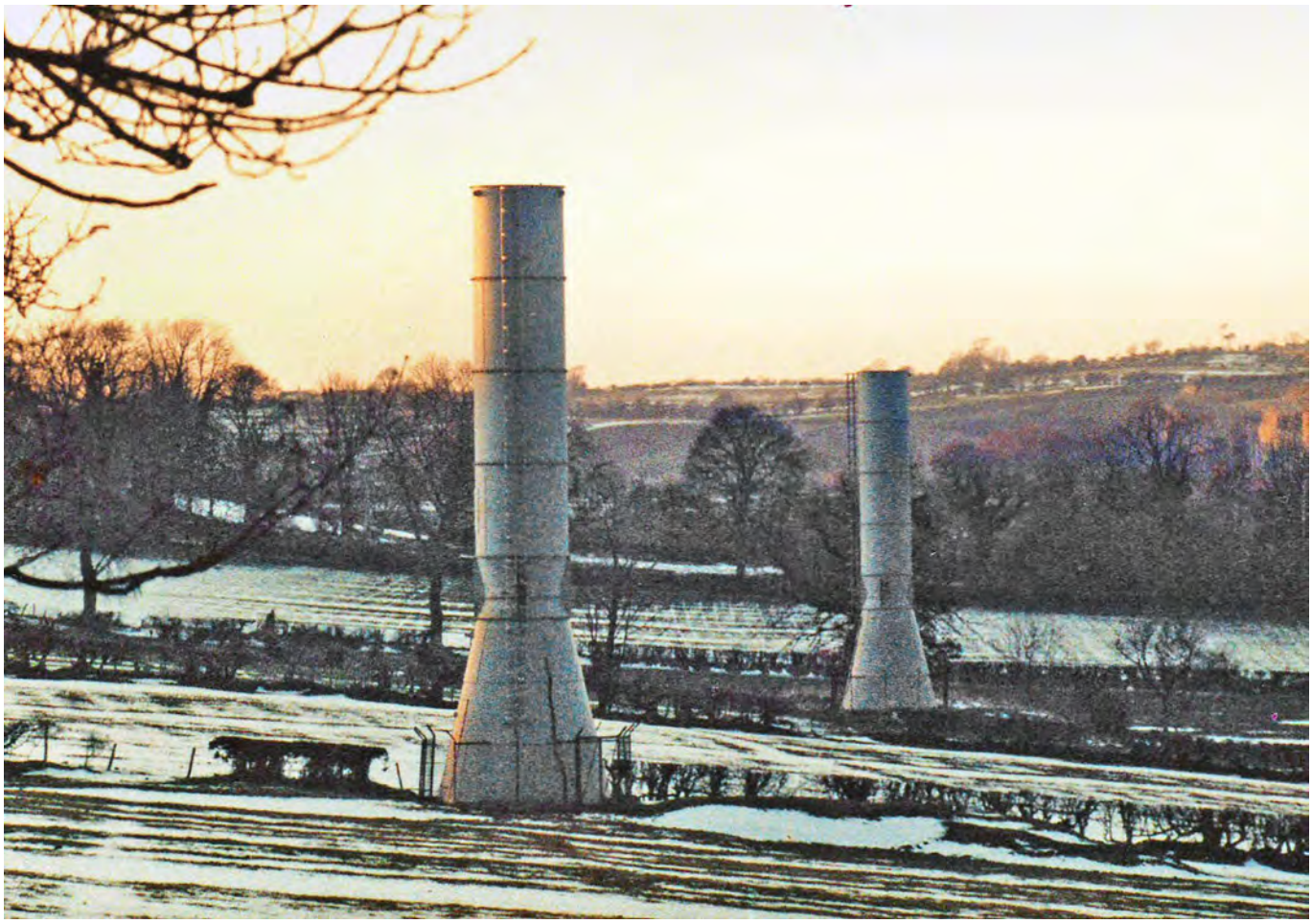
Some years ago I worked at the centre of the Defence of Britain Project, recording sites and archiving many of the photographs. This led on to working at the Royal Aircraft Establishment at Farnborough where I recorded the buildings and machinery. I am an active member of the Fortress Study Group and involved in organising Conferences each year and the odd

European Tour: Netherlands in 2012, Southern Ireland 2013, Mallorca & Menorca 2016 and Malta 2017.

My other passion is my library where I have a large collection of military books and photographs covering all aspects of Conflict Archaeology. I also care for much of the archive material belonging to both the Fortress and Pillbox study groups. I sit on the committee of at least two other archaeology groups and I am a member of around twelve societies. My other interests include gardening and my 'G' gauge garden railway.

Rhydymwyn Visit – a site for sore eyes

Martin Dixon



The vent towers at the far end of the two outer tunnels. They survived into the 1980s. Photo from Valley History Society

Rhydymwyn is a village located in Flintshire, north Wales, a few miles north of Mold. The name literally translates as '*Ford of the Ores*' named after the ford over the River Alyn and the lead, zinc and copper mines that used to be worked in the area. As a rough guide to pronunciation, try 'Riddymuen'.

Lead mines and an iron foundry occupied the River Alyn valley bottom but in 1939 a more sinister operation was set up here. An extensive history is given on the Rhydymwyn Valley History Society (RVHS) website and subterranean elements are on the Sub Brit website but a summary of the post-1939 period follows.

Geneva Protocol

The use of chemical weapons had been outlawed by the Geneva Protocol of 1925 but this did not prohibit their manufacture. Britain feared that Germany might use such weapons on the battlefield in a second world war and felt the nation had to be in a position to respond. Factories were therefore set up to produce mustard gas (and phosgene) and a storage site was required that would be out of reach of the Luftwaffe bombers of the period.

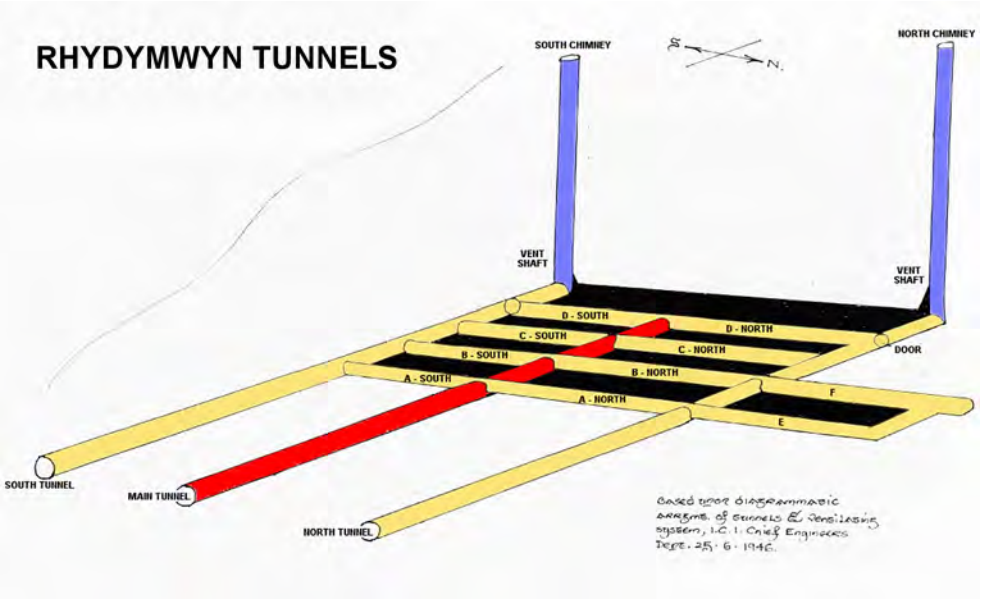
Thus in 1939 the Ministry of Supply (MS) Factory Valley was set up in Rhydymwyn to manufacture and store this deadly substance. Tunnels were bored into the limestone of the valley sides and the spoil used to create an extensive flat area for the factory itself. Part of the River Alyn was culverted to improve vehicular access around the site and into the tunnels.

Building 45, originally designated P6 and intended for mustard gas manufacture. Later converted for use by the 'Tube Alloys' project to concentrate Uranium 235

By the early 1940s, the workforce on site had grown to over 2,000 and areas were designated for manufacture, assembly and storage of mustard gas and delivery mechanisms. Over 3,000 tons of mustard gas were stored within the tunnels and continued to be held long after the end of World War

II. It was only in 1958 that the supplies were finally destroyed and the tunnels emptied.

In a secret within a secret, one of the buildings on site (then designated P6) was used from 1942 as part of the *Tube Alloys* project to test the concentration of Uranium 235 by gaseous diffusion with the intention of producing an atomic bomb. This research was later incorporated into the better known USA-led *Manhattan* project so the small village of Rhydymwyn played a part in the design of the weapon that finally ended World War II.



Food for Thought

After the end of chemical weapon storage, the site was used as a Buffer Depot (strategic food store) by the Ministry of Agriculture, Fisheries and Food. Several dozen Buffer Depots were set up across the country in the Cold War, intended to help feed the civilian population in the event of a nuclear strike. I always think that 'Buffet Depot' would have been a more appropriate name for the stores!

Road tankers for holding Runcol or Pyro in the Rhydymwyn tunnels during the war. Photo from Valley History Society

Other plans for the tunnels were never realised. One was to house NATO Committees for oil and shipping in the tunnels in the event of war. The second (*Project Mallard*) was to house part of the Bank of England's gold reserve here for protection during wartime.

In 2003 many of the remaining buildings on site were demolished and in 2008 the Rhydymwyn Valley History Society (RVHS) was founded to study the Valley Works and their rich history. Their Chairman, Colin Barber, has worked tirelessly to document this history and the RVHS have guided hundreds of people across the site.

Until recently, access to the site was largely limited to a view down the main tunnel from the portal. Undeterred, Colin persevered and by drawing up a risk assessment and method statement has gained approval from DEFRA (Department for the Environment, Food and Rural Affairs) to take groups into the tunnel complex.

Guinea Pigs

This is obviously something Sub Brit wholeheartedly supports and the Committee agreed to make a grant to the RVHS to fund safety equipment (such as helmets, torches and a gas detector) for such visits. We also agreed to provide some 'guinea pigs' for a trial visit which would also be attended by DEFRA and their on-site Facilities Management subcontractors.

Thus it was that at 0900 one Monday in June, fifteen Sub Brit members arrived bleary-eyed in the Valley Visitor Centre. Some attendees were local members from North Wales or Merseyside but others had driven from the Home Counties and even the south coast. Chris Rayner, who had made all the arrangements for our visit and coordinated the grant application was sadly unable to attend at the last minute as he had to attend urgent business meetings in Kent.

The 'goods in' railway loading dock in the 'Danger Area' at the south end of the site. The dock is coated with Colas to reduce the risk of sparks

We were given a warm welcome from Colin and his fellow volunteers and given a well-illustrated presentation on the site's history. We were then talked through the procedures for the visits as agreed with DEFRA. A number of Sub Brit members are active in the RVHS and it is hoped that many of the attendees will become part of the group of guides for future visits to the tunnels. Colin also gave his grateful thanks to Sub Brit for both the funding and for attending this pilot day.

In at Last!

Whilst the Sub Brit party walked through the site to the tunnel portal, RVHS inspectors checked the condition of the tunnels. The level of hazards is low for experienced subterraneans but careful preparation is important for tours by the general public. The inspectors then handed over to the guides and the visit began after all had signed to say they had been briefed and would follow the protocols. We all donned Hi Viz tabards and had helmets and torches provided – all purchased with the Sub Brit grant.

Entrance B into the hillside and the central tunnel. For many years a view from the portal was the most that visitors might expect

Concrete lining in the central tunnel (B). All in excellent condition

The excavation consists of three parallel entrance tunnels, each around 250 metres in length, but our approved visit was limited to the central of these. The mustard gas storage chambers are at right angles to these, forming ten chambers in cross passages each around 75 metres in length and with a cross section of 10 metres (width) by 6 metres (height).

Above the entrance door we could see grilles where the forced air circulation would have entered. Given the toxicity of the material stored here, the ventilation was an important part of the construction and, unusually, the ventilation system had fans at both the entrance and exit points.

The incoming air would have used the full entrance tunnel before being forced up into the ceiling space for the further reaches of the tunnels and extracted from channels beneath the floor and expelled high above the valley floor through ventilation chimneys. This top-down ventilation route was chosen as mustard gas is heavier than air so any leaks would descend rather than rise. Bulk storage areas were designed to have twelve changes of air per hour, requiring an impressive throughput of 287,000 cubic feet per minute!

An example of the WWII graffiti just inside the entrance; the contact mine is particularly unusual

Into Native Rock

The first section of entrance tunnel is fully lined in concrete and around 50 metres in there are recently bored holes which drain straight into the culverted River Alyn. This was reminiscent of the arrangement in the Ouseburn Culvert air-raid shelter in Newcastle which many of us visited a couple of years ago where toilets drained straight into the culverted sewer beneath the shelter. About halfway along the tunnel, the roof and walls revert to native limestone, presumably because there is now more overburden and perhaps the strata are more robust.

We eventually reached the first of the cross passages and could see drainage channels and the supports for the

false ceiling that originally existed. These cross passage linked with the other entrance tunnels to the left (south) and right (north). Signs labelling these storage chambers could be seen, both in original script and accompanied by more recent plastic signage. The floor was level but covered in places by up to an inch of water. Various types of speleothem exist – mostly flowstone but with a few stalagmites and some cave pearls on the floor.

Looking west along the central tunnel just before the junction with chamber 'A', the entrance is behind the photographer. Note the slope showing the ventilation arrangement. The incoming fresh air would have been directed above a false ceiling and extracted from below floor-level

The central tunnel at the junction with chamber 'A' looking out towards the entrance. The gate seen on the right is visible on the left in the picture above

All too soon we reached the end of the main entrance tunnel and could see to right and left the locations of the foot of the ventilation chimneys; sadly these were off-limits for today. At the bottom of the ventilation towers were drainage sumps and (mindful of the potential toxicity of the outflow) a five-mile pipeline had been constructed to take this discharge directly to the tidal River Dee.

Toxic Graffiti

Slowly returning, we were able to see some WWII graffiti which included images of Hitler, incendiary and explosive bombs and a naval vessel approaching a floating contact mine. I also found an inscription at one of the junctions made with a sharp point which read 'Bill Rigby 1957 – 195?' (sic). I knew that Tom, one of our guides and himself in his eighties had worked as an electrician at the site and he confirmed that he remembered Bill, who had been part of the Toxic (clean-up) Team, which was a nice discovery.

Looking north along storage chamber 'A' from the junction with the main passage. Turning left at the far end leads to the north ventilation shafts. Bollards mark hazards

Having been counted back out of the tunnels, the Sub Brit party was able to explore some of the rest of the site (it runs to about 68 acres). From the north downwards, the valley was divided into areas for administration, manufacture, charging and (explosive) assembly. Surface storage supplemented the underground facilities. Some of the buildings still retain their World War II camouflage painting and elsewhere nature was gently recolonising the site.

Many of the buildings still have their camouflage visible (or not visible!)

One of the buildings in the charging area had extensive graffiti – mostly lists of weights in stones, pounds and ounces. It seems curious that potentially important calculations were entrusted to the walls of the building rather than paper! We could see where the culverted river emerged and also traces of the railway network (there was once a standard-gauge connection and an on-site narrow gauge railway). Across the river and now hidden in woodland was the original plant that extracted water for the site.

The *Tube Alloys* Building

Mustard gas was made in two variants by the UK, codenamed *Runcol* and *Pyro*. Two plants, designated R3 and R4, were built on site to manufacture *Runcol* while

three *Pyro* Factories, known as P4, P5, and P6, were constructed. The Rhydymwyn site also received mustard gas from other plants and sent some of its own production in bulk to Forward Filling Depots (FFDs).

Sub Brit members head towards building P4. This Grade II listed building was intended to house plant for the production of Pyro mustard. As the threat of invasion receded the building wasn't used for production. P5 was used to refine Pyro mustard produced at other factories and P4 was a fully-operational back-up facility

For many, the surface highlight was a visit to building P6 (more recently redesignated Building 45 by the previous site custodians Carillion). This is a large multi-bay barrel-roofed structure with a single concrete tower. Although originally built for *Pyro* manufacture, the building was reused for the *Tube Alloys* programme and the floor still bears evidence of the footprint of plant. Some of the space was portioned for use as offices; trackways for overhead cranes still remain in place.

Interior of the Tube Alloys building

Some of the concrete 'gravestone' markers labelled 'Toxic Burial Pit' dating from WWII have been recovered from elsewhere on site and are now stored in the building. P6 now houses a small colony of lesser horseshoe bats which are being monitored by local naturalists.

Much of the wider site now operates as a nature reserve and there is a wetland (fed from the tunnel drains!) and a recently planted orchard. There are also artificial badger setts and sand martin burrows to encourage wildlife.

There has apparently been some lack of alignment between the group overseeing the nature reserve and those more interested in the site's industrial history. This seems a great pity as the site is large enough to accommodate both interest groups. Such a harmonious relationship certainly exists elsewhere – for example across the UK's canal network where the natural and built environments happily co-exist.

Return and Refreshment

We returned to the visitor centre and were surprised and delighted to see an extensive and sumptuous lunch prepared by Colin's wife, Jacqui. Over lunch we were able to chat to RVHS members and to DEFRA. Although there may be some minor details to follow up on, it seems that regular (two or three times a year) public visits into the tunnels will shortly be available. We are grateful to Colin and the rest of the RVHS for the great welcome we received and for all their hard work in securing access to the tunnel network.

Changing rooms in the 'Danger Area'. The 'Danger Area' which was isolated from the rest of the site is where the manufactured munitions were charged with fuses and detonators. The road surface changed from concrete to Colas in this area. This was to reduce the risk of a spark from something being dropped onto the floor igniting one of the weapons being filled

The future of the wider site should be secure – a number of the buildings (including P6) have been given listed building status and the wider site has been designated by Cadw as a scheduled ancient monument. MS Valley Factory is a rare survival of the genesis of two of the most horrific and indiscriminate weapons of the 20th century – one which is now outlawed and the other which brought about the end of World War II and arguably prevented World War III.

To quote George Santayana: 'Those who cannot remember the past are condemned to repeat it'.

The official public opening will be over the weekend 10/11 September. Further tunnel open days will be 25 September and 2 October. Contact Valley History Society for details.

More information on the site is on the Rhydymwyn Valley History Society Website: https://rhydymwynvalleyhistory.co.uk and on the Sub Brit website: www.subbrit.org.uk/rsg/sites/r/rhydymwyn/report.html

All photos, unless otherwise credited, by Richard West.

Sub Brit's Northern Ireland Weekend

Chris Rayner

Grey Point Fort's pentagonal form and promontory location are clearly seen from above. Photo from N.I. Historic Environment Division

SubBrit's Autumn Meeting this year will be at Queen's University in Belfast on Saturday 15 October, and will be followed by two days of visits on the Sunday and Monday (16 & 17 October) to take advantage of being in Northern Ireland and some of the very interesting sites there.

Northern Ireland has a good track record of building underground spaces, stretching back to the souterrains of the late Iron Age period. These are very interesting structures, comprising single-person-wide passages leading to chambers which can only be accessed by crawling. They may have been food stores or refuges in times of strife, and are a tempting addition to the visits programme just to see how many SubBrit members one would take at one time.

Ireland has been an important area for mineral exploitation since antiquity, as shown by the 4500-year-old dating of a copper mine in Killarney, making it the oldest in northwest Europe. Over the centuries many different rocks and minerals have been mined or quarried for a variety of purposes, and even today gold and gypsum are mined in Northern Ireland.

Coal mining too was also an important industry in the province up to the 1970s when the last mine at Coalisland in Co. Tyrone closed. Among its many uses was the production of gas – used initially for street lighting and later for domestic lighting, heating and cooking.

Carrickfergus Gasworks

Carrickfergus Gasworks began in the 1850s and is the only surviving, even if not still working, coal gasworks in Ireland. Although the first gasworks in the Belfast area was set up in 1822, most began at about the same time as Carrickfergus's, as this was a phase of rapid urbanisation in the north following the great famine. The production process was at a terrible cost though, the stokers who fed the furnaces tending to die of lung conditions within a handful of years.

Coal gas, also known as "town gas", was produced by burning coal in a sealed retort, and passing the resulting gases through a water trap to provide a flammable gas which could be used to provide street lighting, and could even be piped into the homes and shops of subscribing customers. Private take-up increased with the development of domestic gas cookers, a large collection of which is housed in one of the gasworks buildings. One of these, the Black Prince, was rented to poorer households in the 1920s for an annual charge of 6d.

The second gasholder in Carrick in the late 1940s/early 1950s. Photo from Flame Gasworks Museum of Ireland

The gasworks closed in 1967, a victim of cheaper and cleaner technologies, but was luckily mothballed, allowing it to survive into the modern age of Lottery grants and EU funding, and ultimately being opened to the public as a visitor attraction in 2002 (www.flamegasworks.co.uk).

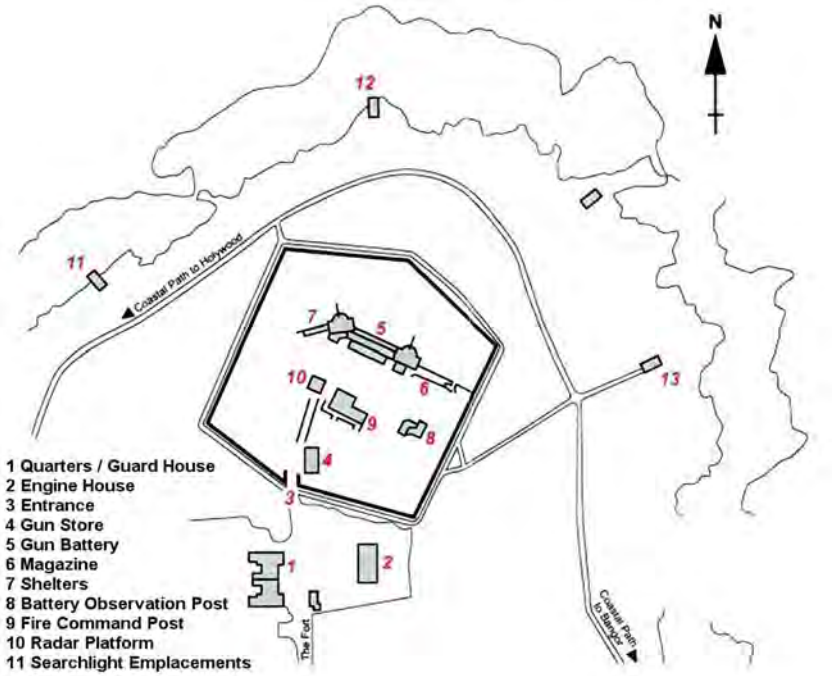
The retort house at Carrickfergus contains 36 horizontal retorts in three beds, which were heated by a furnace in the building's basement. Coal placed inside these airtight retorts was heated up to 1200º C over a period of about six hours to produce gas. The gas had contaminants within it, including tar, ammonia and hydrogen sulphide, which had to be removed by passing it through water condensers, then through a scrubber to remove the remaining tar, and finally through iron-oxide beds to take out the hydrogen sulphide. Very little was wasted though; the burned coal was sold off as coke, the ammonia went to make fertiliser, and the condensed tar was used to repair roads and roofs.

An array of retorts at the gasworks. Photo Tarboat

The final stage in the process was when the gas was taken into the gasholder to be stored. Carrickfergus's larger gasholder, built in 1949, holds 200,000 cu.ft of gas and comprises two inner cylinders, which rise up as it fills, with a base layer of water to act as a gas seal. SubBrit visits don't usually include roofs but a gasholder roof has to be one of those exceptions.

Grey Point Fort

Almost directly opposite, on the other side of the large sea inlet of Belfast Lough onto which it fiercely looks out, lies Grey Point Fort. This pentagonal-shaped coastal battery and gun emplacement was built on a promontory near Bangor a decade before the First World War, becoming operational in 1907, and its job was to protect the entrance to Belfast Lough using its two massive 6-inch-diameter guns.



Plan of Grey Point Fort.
From Northern Ireland Environmental Agency guide

Any ship entering the harbour in wartime would be challenged by Coastal Defence personnel and, if it failed to respond, would be sent the more urgent "Heave To Or Be Sunk" message which removed any remaining ambiguity in the minds of its recipients. It worked in conjunction with a more accessible "examination depot" on the north side of the Lough at Kilroot.

The fort dates from a period when few forts were built in Britain and has a number of unusual features making it worthy of inclusion in the SB visits programme, not least its unique collection of wartime radio equipment. The site was well chosen and has a stunning outlook which also shows in part why Belfast would come to be the city it is today, having been established at the narrow end of the deep waters of the Belfast Lough, sheltered by the Belfast and Castlereagh Hills.

The two 6" guns at Grey Pont Fort. Photo David Mitchell

The Belfast Blitz

During the Second World War, the fort's armaments were bolstered with a 3-inch anti-aircraft gun, a single Lewis gun, and two 6-inch guns, and on Easter Tuesday 1941 it offered what little help it could give during the Belfast Blitz. The city suffered heavily though, thanks to the complacency of the governing Executive Committee and other government officials who had stubbornly clung to the belief that the city would never be attacked.

Even though Belfast's shipyards and factories were heavily involved in the war effort, the city's distance from the continent and the much more tempting targets that would need to be overflown before the city was reached seemed to them to guarantee its immunity. There was also a belief that it would somehow be protected by the umbrella of the Irish Republic's neutrality.

Magazine at Grey Point Fort is between and below the two guns. Photo Conor Stanley

Northern Ireland would have an uneasy relationship with the Second World War. Sectarian divisions split the province in two, with the nationalist minority against the war at best, and even pro-German in a few cases. They saw the war as Britain's war, nothing to do with them. It was for this reason that conscription was never introduced in the province, in tacit acceptance that it would cause more problems than it solved.

This anti-war feeling and mistrust even extended to civil defence and there were public burnings of gas masks in republican areas and painted slogans such as "ARP stands for Arrests, Robbery and Police". Civil defence preparations in any case were woefully inadequate and at the beginning of 1941 it was said that there were just four shelters in Belfast, of which two were underground toilets.

By the time of the Blitz, more had been built, but Belfast would still have the lowest proportion of shelters per head of population of any major city in Britain. Hardly any children and other vulnerable groups had been evacuated to safer areas, and the city's defences also were almost non-existent. There were no searchlights, no night fighters, no smoke screens, hardly any barrage balloons and only twenty or so anti-aircraft guns.

The enemy raid on Easter Tuesday caused the greatest loss of life in a single night-time raid outside London. Tragically, many misread the German pathfinders' flares as a fireworks show. More than 900 people would be killed in the raid, over half of the city's houses were damaged or destroyed, and 100,000 made homeless.

Battery Observation Post at Grey Point Fort. Photo Andy Glenfield

Most of the shelters were brick surface ones, described as "reasonably safe, but if a bomb dropped close to them, they collapsed in a heap of rubble". Thirty people were killed in a shelter in Percy Street, and another eleven in Thorndyke Street, when the concrete roof of their surface shelter collapsed. Many are thought to have died from blast fragments while trying to flee the city in desperation because there was nowhere to shelter safely.

There were even reports of rats deserting their sewers to join the exodus.

The raid briefly united the two communities. In one shelter, an apocryphal story goes, young members of the rival communities faced each other and sang their tribal songs in turn, but then, as the bomb blasts came closer, their songs grew more hesitant until finally they all began singing "Nearer My God To Thee".

Elsewhere in the city, the Catholic Clonard Monastery opened its crypt as a shelter to Protestant families from the Shankill Road, while fire tenders from the Republic crossed the border to offer assistance. The *Irish Times* from Dublin saw great promise in this, declaring that "Humanity knows no borders, no politics, no differences of religious belief. Yesterday for once the people of Ireland were united under the shadow of a national blow. Has it taken bursting bombs to remind the people of this little country that they have common tradition, a common genius and a common home? Yesterday the hand of good-fellowship was reached across the Border. Men from the South worked with men from the North in the universal cause of the relief of suffering."

Brownlow House

A happier period of the war is revealed at Brownlow House, an imposing Victorian house known locally as Lurgan Castle. During the First World War it had been used as the headquarters of the 16th Battalion Royal Irish Regiment, but during the Second World War it played a far greater role when it became the headquarters of US forces based in Ireland from 1942 onwards. Having an impressive, if fake, Elizabethan appearance and oddities like 52 chimneys and 365 rooms, it would strongly have appealed to its American tenants. Supreme Commander General Eisenhower visited the house during the preparations for the D-Day landings.

Wartime graffiti at Brownlow House, the headquarters of the US armed forces in Northern Ireland.
Photo Andy Glenfield

Today it hosts a fascinating museum documenting the US presence in Northern Ireland during WWII and a local First World War exhibition, but more particularly contains some superb wartime graffiti in its basement.

Ulster Aviation Society

Another important wartime site can be seen during a visit to the Ulster Aviation Society's collection near Lisburn, which gives the opportunity to see up close an eclectic collection, including planes as diverse as a Grumman Wildcat, a Buccaneer, an F4 Phantom and a Canberra, all housed within two very large wartime hangers on the site of RAF Long Kesh and the Maze Prison.

The Ulster Aviation Society's hangars (a watchtower and wall of The Maze prison are visible to the rear).
Photo Chris Rayner

Work in progress on a Shorts Tucano prototype and Canberra PR9 in one of the UAS T2 hangars.
Photo Chris Rayner

RAF Long Kesh was originally set up as a Ministry of Aircraft Production site for the manufacture of bombers, and was used by Shorts and Harland to build Stirling heavy bombers before production was transferred to another site. Fighter aircraft were also stationed here to deter an enemy paratroop attack, which, as it happens, was not as outlandish an idea as it might first seem.

Unternehmen Grün (Operation Green), the planned invasion of Ireland by Germany as a bridgehead for an invasion of Britain, was only abandoned by the German High Command in March 1942, and Long Kesh would have been one of the initial targets.

Reproduction ROC Operations Room at the Ulster Aviation Society. Photo Chris Rayner

Several hangars were erected, of which two very large type-T2 hangars survive, and other survivals include control and gas decontamination buildings and some unusual pillboxes. In 1971, part of the disused base became the Long Kesh Detention Centre, also known as the Maze Prison, where for three decades paramilitary prisoners were interned. The H-blocks, of which one survives directly opposite the Ulster Aviation Society's hangars, were built in the mid-1970s.

Crumlin Road Gaol

The Troubles are also recalled at Crumlin Road Gaol, another of the sites that will be visited during our Sub Brit weekend. The gaol is a classic Victorian-era prison, built in 1845 and in service until 1996, and has the familiar layout (possibly too familiar for any SubBrit members who may have been detained at Her Majesty's pleasure at HMP Pentonville) of wings radiating out from a central core known as "The Circle". In all there are four wings, each four storeys tall, and nearly 550 cells.

Tunnel from the Crumlin Road gaol to the Courthouse. Photo Andy Glenfield

Over the years, the prison has housed "murderers, suffragettes and loyalist and republican prisoners" and,

'The Circle', the central monitoring point at the Crumlin Road gaol. Photo Andy Glenfield

despite being referred to as "Europe's Alcatraz", suffered a number of successful prisoner escapes. The SubBrit visit will include the tunnel by which prisoners were transferred from the Gaol to the nearby Crumlin Road Courthouse.

Cold War period

The Cold War is also represented in the visits programme, by the Northern Ireland Regional War Room at Mount Eden Park, in the western suburbs of Belfast. This was built in 1952 as a War Room and Regional Seat of Government, a position it held for about six years until the RSG role was transferred to Gough Barracks.

Aerial view of Mount Eden Park RSG & RGHQ showing its suburban location

The bunker became the Belfast Corporation Control from about 1962, and had six 1950s sub-controls reporting to it, and then, after another period of rest, became the Northern Ireland RGHQ in the early 1980s until 1990, when the newly built Ballymena bunker took over that role. Currently it's in use as a records store by the Public Prosecution Service.

An exercise underway at the Belfast County Borough Main Civil Defence Control at Mount Eden Park in the early 1980s

Much of our knowledge about its period as a RGHQ comes from the unauthorised visit in December 1983 of two CND activists. One of these, Peter Emerson, later described their visit in an interview with *INNATE*, the Irish Network for Non-violent Action Training and Education.

> "In 1983, remember, we broke in on the Saturday. Paddy and I stayed on site while others took away the films to be developed – an old-fashioned pre-digital word – and then issued a press release; hence the front-page coverage in the *Irish News* and *Irish Times* on the Monday morning…. Meanwhile, yes, we stayed on site. The police were calling by about every 30 minutes or so, and although we had broken the law, we nevertheless wanted to create the impression that we hadn't, at least until the press release went out. But then, on the Monday morning, we reported ourselves to the groundsman... much to his shock horror.
>
> "A string of officials then came to inspect the scene of the crime, including the police who told us we had committed an offence (trespass, breaking and entry, and disturbing the peace), to which we responded by saying we had known that already, which is why we had reported the fact. Of course, no arrests were ever made. The NIO then held a press conference in the bunker – so it was a bunker and not just "a store", their earlier story – so to fully vindicate our NI CND position. BBC NI put something onto their news bulletin, and I distinctly remember them saying that we (Paddy and I) "were not available". The phrase has often been a euphemism, of course, and it's probably fair to say that they did not want to interview us."

Several photos from their visit are shown on *INNATE*'s Flickr pages and include maps which suggest the bunker had participated in Operation Warmon in October 1983, an exercise in which fallout patterns following nuclear strikes on Ireland were plotted.

Photograph of teleprinters during the 1983 break-in by CND at Mount Eden Park. Photo Peter Emerson & Paddy McBride

Stormont Sub Control and Ballymena

A fleeting visit to the Stormont Sub Control, affectionately known to its former maintenance staff as the "Rat House", is also planned if there is time, although this will be an external visit only as the Northern Ireland Government has ruled out an internal visit for safety reasons. At the time of the SubBrit visit in 2002 it was in use as a government document store, but it is now understood to be flooded and empty.

The Ballymena RGHQ, one of the last Cold War bunkers to be built and which was featured in the last issue of *Subterranea*, is in the process of being sold which has prevented, at the date of writing, any definite arrangements for access during the October visits programme, although it may yet be added to the schedule at short notice. Many of its artefacts have been put into safekeeping by SubBrit member Alistair McCann, and may be seen during the Ulster Aviation Society visit.

Stormont's 1950s Sub Control understood to have been sealed since 2011. Photo Chris Rayner

Other Sites

The difficulty with arranging any visit is deciding what's achievable and what to leave out for another day. The Lissummon Railway Tunnel, the longest railway tunnel in Ireland, would have been a great addition to the programme and we had arranged permission with the

landowner, but the wet summer is likely to have turned the approach cutting into a quagmire.

Further afield, there are a number of sites that would be worthy additions to an extended visit to Northern Ireland. Several of these are well documented on the SubBrit website, including Campsie AAOR and the RAF Murlough Bay ROTOR Radar Station on the beautiful north coast, and the Marble Arch caves in the southwest. There are also many other excellent sites, many of which are documented on Andy Glenfield's website, referred to below.

Thanks to Alistair McCann and Andy Glenfield for background information; Alistair's website on his Portadown ROC Post www.nibunker.co.uk/ and Andy's on the Second World War in Northern Ireland ww2ni.webs.com/ are both highly recommended.

Thanks also to INNATE for the Peter Emerson quotation extract and to those who have offered to host visits by SubBrit members in October.

Is this London's smallest Tunnel?

Stewart Wild

Avenue House is a Victorian mansion dating from 1859 set in ten acres of grounds alongside East End Road, Finchley, north London. It was bought and enlarged by ink magnate Henry 'Inky' Stephens in 1874. Stephens was a wealthy man and went on to become MP for Hornsey and Finchley in 1888.

'Inky' Stephens died in 1918 and in his will he left Avenue House and gardens "for public enjoyment" in the care of Finchley Urban District Council. Since then the building has housed at various times a school, a public library, council offices and a magistrates' court.

The freehold of the estate is owned by the London Borough of Barnet while the daily management is now undertaken by an independent charitable trust. Last year, in connection with a successful bid for a grant from the Heritage Lottery Fund, the ten-acre estate was rebranded as Stephens House and Gardens.

Within the house rooms are let as offices and meeting venues, while in the conservatory the Stephens Collection is a small museum featuring local history, the Stephens family history, and artefacts related to the development of Stephens' Inks, a successful manufacturing company for over 150 years.

The house has a large basement area, including a well, that is normally off-limits for visitors but is used for ghost-hunting events around Halloween. Several of the basement rooms are used by local organisations for storage and archives.

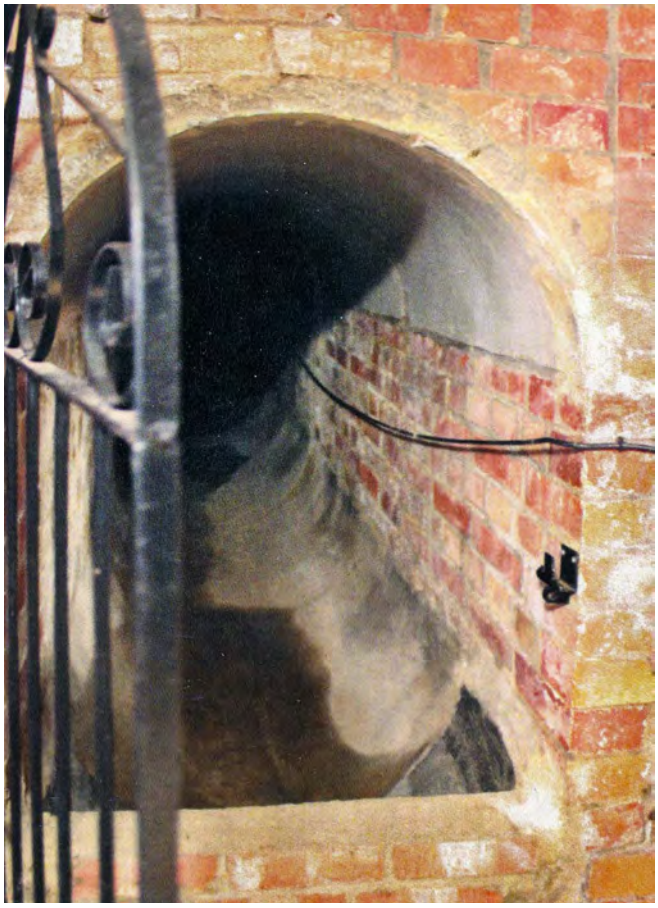
Avenue House at War

During WWI the house was requisitioned as a convalescent hospital for injured servicemen, and after the war, in 1919, it became the Central Hospital of the Royal Air Force, which it remained until 1925. At that time the basement area still housed a kitchen and staff quarters.

In September 1939 the house, stables and garages were again requisitioned, this time for use as Air Raid Precautions headquarters for Finchley, and an Auxiliary Fire Service station was established on the site. The upper room in the water tower was used for fire-watching during air raids.

Part of the basement, reinforced with steel girders, became an ARP control room and air-raid shelter. It was at this time that an escape tunnel was excavated through the basement wall to provide an emergency exit up concrete steps to a manhole in a lawn some forty feet (12m) from the building.

The brick-lined tunnel, egg-shaped but with straight sides, is 38ft long, 2ft 7in wide and 4ft 6in high (11.50 x 0.80 x 1.37m). Is this the smallest tunnel in London?



Exhibition

In the summer of 2015, to commemorate the centenary of the First World War and seventy years since the end of WWII, an exhibition entitled *Avenue House at War* was mounted in five of the basement rooms. This was the first opportunity for many visitors to explore the basement and cellars and the escape tunnel was a surprise discovery for almost all of them.

The estate gardens are open all year round, dawn to dusk. Avenue House, the basement and the escape tunnel may be visited by Sub Brit members by prior arrangement with the author, who lives locally and is a trustee of The Stephens Collection.

Further information: www.stephenshouseandgardens.com

Discounted Cotswold Shopping

Cotswold Outdoor have granted Sub Brit members a 15% discount on their products (excluding sales and special offers). The details are included in a letter on the website at www.subbrit.org.uk/docs/discount-cotswold-outdoor.pdf

If you are not able to access the website, then please contact us with an SAE for a copy of the letter.

The discount code can be used in any of their 58 stores (there is a barcode on the letter), and for telephone and online orders.

**** Please do not share or abuse the code as this may lead Cotswold to withdraw it which would be a great shame and spoil things for the rest of our members. ****

Here is an introduction from David Hague of Cotswold:

"Cotswold Outdoor are proud to be a supporter of such a prestigious organisation as Sub Brit. As most of your members are aware, Cotswold Outdoor is a multi-award winning retailer with numerous thriving stores located nationwide. Not only are we proud of our knowledgeable staff, but our stores stock one of the most comprehensive ranges of outdoor clothing and equipment in the UK. With a huge range of footwear, waterproof jackets and fleeces, tents, sleeping bags and outdoor accessories, we offer one of the best selections of clothing and equipment right on your doorstep.

Whoever you are and whatever you need, when you shop with us you can be assured of expert, award-winning service and advice that comes from 40 years of experience in retailing. We're really looking forward to welcoming you to our store, online or over the phone soon. I hope that our discount helps your members purchase the right kit and equipment as they continue with their important and valued pastime. We are passionate about giving the right advice and recommending the right clothing and equipment so you can have peace of mind while out in (or should that be under!) the field."

SPECIAL DISCOUNT

SUBBRIT are pleased to announce that we have negotiated a members' discount with

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